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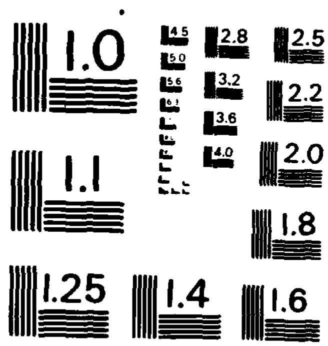

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Wright-Patterson Air Force Base, Ohio

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AFIT/GEM/LSM/85

IDENTIFICATION OF DESIRED COMPUTER CAPABILITIES FOR MANAGEMENT OF AN AIR FORCE BASE LEVEL CIVIL ENGINEERING DESIGN OFFICE

THESIS

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THESIS

Presented to the Faculty of the School of Systems and
Logistics of the Air Force Institute of Technology
Air University
In Partial Fullfillment of the
Requirements for the Degree of
Master of Science in Engineering Management

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September 1985

Approved for public release; distribution unlimited

Acknowledgements

We wish to thank our advisor, Mr James Meadows, for his cheerful support and assistance in the preparation of this thesis. We sincerely thank Captain Jeffrey R. Charles of the AFIT School of Civil Engineering. His thoughtful assistance, expertise on the subject matter, and cooperative attitude were material to our success. In addition, we wish to thank Major Timothy N. Beally also from the Civil Engineering School, for his advice, and inspiration.

We sincerely appreciate the help of those persons who took the time and effort from their busy schedules to respond to our questionnaires. Their contributions are the essence of this thesis.

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Abstract

Computer systems are becoming more important in the management of the different branches within an Air Force Civil Engineering organization. One of the primary items that determines the effectiveness and efficiency of a computer system is the development of the software. Before the software can be developed, the desired capabilities of the computer system need to be identified.

This thesis identifies computer capabilities that Chiefs of Engineering Design and their immediate supervisors desire for use in managing base level Air Force Civil Engineering Design Offices in the Continental United States. These capabilities were identified by having managers from engineering branches in Air Force Civil Engineering organizations evaluate 74 potential computer capabilities. Respondents were also able to comment on the identified capabilities and to identify any other capabilities that they may desire. The many and in some cases quite lengthy comments received show that the respondents are interested in this subject.

The vast majority of respondents' comments were very positive and expressed their need for help in developing required computer support. In response to this requirement, many bases have procured minicomputers and the

Air Force is in the process of procuring computers for the Work Information Management System (WIMS) for each base. WIMS is a series of desktop terminals connected to a central computer system with a common data base for use by all Civil Engineering managers. The results of this thesis will be used in the development of software for the WIMS computers.

The identified computer capabilities are prioritized in two different ways. First, they are prioritized based upon the percentage of respondents classifying a particular capability as "very useful." Second, they are prioritized based upon the percentage of respondents classifying a particular capability as "very useful" or "moderately useful." These priority lists are not intended to show what capabilities should or should not be developed, but only as a means to focus resources in the development of the capabilities.

The effects of various demographic factors upon the perceived usefulness of the identified computer capabilities were analyzed. The analysis was accomplished by dividing the respondents into nine different groups based upon the responses to the demographic questions contained in the questionnaire. There were no major differences between the groups.

IDENTIFICATION OF DESIRED COMPUTER CAPABILITIES
FOR MANAGEMENT OF AN AIR FORCE
BASE LEVEL CIVIL ENGINEERING DESIGN OFFICE

I. Introduction

Overview

Computer systems are becoming more important in the management of the different branches within an Air Force Civil Engineering Organization. One of the primary steps that determines the effectiveness and efficiency of a computer system is the development of the software. Before the software can be developed, the desired capabilities of the computer system need to be identified.

Prior to this thesis there was no comprehensive list of desired capabilities for a computer system for the Chief of Design in an Air Force Civil Engineering Squadron. The Air Force is in the process of developing and purchasing standard computer systems for the Chief of Design, but before a comprehensive software package can be developed, specific applications have to be identified. The primary people who can identify these applications are people who are serving, or have served, as the Chief of Design.

This thesis used input from Chiefs of Engineering Design and their immediate supervisors, the Chiefs of Engineering and Environmental Planning, to identify the

computer capabilities they believe would be useful to the Chiefs of Engineering Design in managing base level Air Force Civil Engineering Design Offices. The goal of the thesis was to identify the computer capabilities needed by the Chiefs of Design in the accomplishment of their mission. These capabilities are identified and presented in such a manner that the information can be used in development of computer systems for the Chiefs of Design. The investigation was limited to Continental United States (CONUS) base level operations because of the time constraints faced by the authors in completing their research effort.

Background

According to AFR 85-10,

> The primary mission of civil engineering activities is to acquire, construct, maintain and operate real property facilities, and provide related management, engineering and other support work and services (5:2).

The complex nature of this mission requires several different branches within the civil engineering organization. These branches are Financial Management, Industrial Engineering, Squadron Section and Administration, Fire Protection, Family Housing Management, Operations, and Engineering and Environmental Planning. Within the branch of Engineering and Environmental Planning, there are four sections: design, contract management, environmental and contract planning, and real

estate. The design section has a variety of responsibilities. According to AFR 85-10, these responsibilities are:

- -prepares, coordinates and designs projects, including plans, specifications and cost estimates, for all work to be done by contract.
- -develops architectural and engineering reports including but not limited to economic and engineering justifications.
- -prepares Architect-Engineer statements of work and participates in the selection of A-E services.
- -provides architectural and engineering advice and assistance.
- -prepares design criteria for projects to be designed by other agencies.
- -performs corrosion and utility leak surveys.
- -prepares architectural and engineering drawings, miscellaneous charts, forms, maps, area surveys, and collects data to be incorporated in location maps, records and systems.
- -prepares and maintains record drawings.
- -provides professional engineering guidance for improvement and application of energy systems.
- -prepares economic analysis based on present worth techniques to determine a benefit/cost ratio for energy conservation projects.
- -prepares and maintains the utility brochure. Reviews utility invoices and determines utility sales rates.
- -reviews and develops the technical provisions of utility contracts and assists the procurement officer in negotiating utility contracts (5:12-13).

The overall accomplishment of these responsibilities is the job of the Chief of Design, who has to manage a large quantity of factual data and use it to make many decisions.

Many Base Civil Engineers (BCE's) have obtained small computers such as the Apple, IBM PC, or Zenith 100; and design section personnel are obtaining software to assist themselves in managing their information. There has been no collective effort to assist them in developing common programs or software that meets their needs. More

importantly, the Air Force is in the process of obtaining Work Information Management System (WIMS) computers for Base Civil Engineering organizations. "The main objective of WIMS is to improve individual job performance and organizational effectiveness" (21:1). WIMS will serve primarily as a management information system (MIS), and will eventually be used to some extent as a Decision Support System (DSS).

As currently planned, WIMS will help the Chief of Design manage essential data to assist him in decision making. This aspect of the system is still under development. This thesis will identify the capabilities that are desired in the field so that they can be incorporated into WIMS and other Civil Engineering computer systems.

Justification for Study

The identification of the desired computer capabilities and their incorporation into Civil Engineering computer systems will allow the Chief of Design to make better and more informed decisions. It will also contribute to the development of WIMS as a management information system/ decision support system for use by all members of Civil Engineering. Therefore, there is a direct operational application for the results of this research.

Problem Statement

General Issue. The Chief of Engineering Design makes decisions concerning a variety of activities. He manages the design of many projects and assists all base activities with engineering technical matters. The Chief of Design also frequently appears before various boards and committees to provide them with advice as to the feasibility of proposed actions and to brief these bodies concerning the status of construction projects. He prepares a wide variety of reports and briefings for his chain of command and other organizations. There are many other tasks that the Chief of Design and his subordinates must accomplish. A fundamental management problem for the Chief of Design is to allocate his resources to complete as many of these activities as possible in a timely manner. He must consider a variety of factors and apply judgement to achieve optimum productivity; and he must manage the associated facts collectively for his own use as well as the use of his chain of command and other organizations. The Management Question here is: Can the computer capabilities that are appropriate for managing a Design Section be identified, analyzed, and rated in a meaningful manner so as to provide useful assistance to those who will eventually design and implement computer systems for Civil Engineering organizations?

Research Objectives. The objectives of this research are, 1) to determine what computer capabilities are required in order for the Chief of Design to do his job, 2) to determine which of these capabilities are the most desirable, 3) to determine if there is any specialized subgroup of desired capabilities based upon such factors as base size, experience, job description, or similar category. The ultimate goal will be for this information to be incorporated into the design of computer systems for Civil Engineering.

Investigative Questions. Is there any existing research in this area? What tasks consume design section resources? What are their relative priorities to the Air Force? By what criteria do we judge relative priority? Should there be different capabilities for different bases and if so what are those capabilities? Whose ideas and opinions should be considered in identifying the capabilities? Whose ideas and opinions should be considered in determining the relative merit of each capability? What are these people's thoughts? Can all this be converted into something that is useful in the decision-making process? What considerations should be given to the fact that the end use of the research will be to help design a management information system? What is the most practical way to obtain the answers to these questions? How can validity be tested?

Scope and Limitations

The scope of this research effort is to develop a list of computer capabilities desired by the Chief of Design in carrying out his job responsibilities. This research is further limited to Air Force Civil Engineering Organizations in the Continental United States (CONUS). This research effort will not attempt to develop computer programs or a DSS because of time constraints. The results of this thesis will be a first step in the development of an MIS/DSS for the Chief of Design.

Assumptions

The first assumption made in this research is that the computer capabilities needed by the Chief of Design can be identified. A second assumption is that there are some correlations between the desires of the various Chiefs at their respective bases. A final assumption is that the identified capabilities can be rated in some meaningful way.

Definitions

"Computer capability" is an operational capacity to accomplish a data management task or specific manipulation of data to create a specific output for direct support of management. This term does not include hardware specifications such as memory size, speed, language, or similar parameters.

"Design Schedule" is a term with a variety of definitions. One use is simply to describe a list of priorities for the accomplishment of architectural and engineering design projects for the Engineering Design Section. "Design Schedule" is also used to describe a detailed schedule of design project names, people who are working on each project or who are scheduled to work on it, estimated start and completion dates, cost estimates and fund cites, and other similar information. This thesis uses the latter more detailed meaning.

"The Chief Engineer" and "The Chief of Engineering and Environmental Planning" are used synonymously and refer to the Chief of the Engineering and Environmental Planning Branch.

"The Chief of Design" and "The Chief of Engineering Design" are used synonymously and refer to the Chief of the Engineering Design Section.

II. Literature Review

Introduction

This chapter reviews current literature on obtaining computers to assist in managing an Air Force Civil Engineering Design Office, and using computers in Management Information System and Decision Support System roles. The goal is to provide an overview and understanding of the existing state of the art without going into exhaustive detail about any one aspect of the use of computers.

The following topics are discussed: Base Engineering Management System computers, current desk top computer systems in Civil Engineering, Work information Management System Computers, electronic data processing, management information systems, decision support systems, design office productivity studies, and computer aided drafting and design.

The Air Force plans to obtain two new computer systems for use in Civil Engineering Design Offices. They are the Work Information Management System (WIMS) and a Computer Aided Drafting and Design (CAD) system. One objective of this literature review was to identify the capabilities that those computers will have to assist in managing a design office. A search of Air Force literature on WIMS and CAD proved that very little written information exists. Therefore interviews with experts were used to obtain

current information, and civilian literature was researched to find background data to describe various aspects of the use of computers in civilian design offices. This research focused on literature written since 1980.

Definitions

The following summary of an article by Raho and Belohlav defines and clarifies some terms:

> -Electronic Data Processing (EDP)
> Data is the primary interest in an EDP system. Data is simply a collection of 'raw facts' on internal and external events. The function of the EDP system is to change the data into a form where [from which] relationships can be drawn (23:18).
>
> -The internal output of an EDP system consists mainly of declarative reporting and summary reports. . . . The initial impetus for the creation of an EDP system is frequently generated by the observation of an excess volume of data. . . . rather than as a part of a systematic channel of information throughout the organization (23:18).
>
> -Management Information Systems (MIS)
> In contrast to the EDP system, a MIS views not just the transformation of data but how it can be turned into useful organizational information. In an MIS, information is data which has been processed in such a manner that the integration and presentation of individual bits of data become meaningful to a variety of potential users, primarily middle and upper management (23:19).
>
> -An MIS places the burden on the user to select the meaningful information and discard the remainder (23:19).
>
> -Decision Support Systems (DSS)
> In DSS, the focal point is not on data or information per se, but on the end product--the manager's decision. A DSS is a vehicle to help managers to make more informed (and hopefully better) decisions. Therefore, a DSS is oriented to <u>the individual manager</u>. . . . the system must be <u>driven by the manager's</u> personal decision-making methodology

(23:19).

-It should be noted that a DSS will not make a decision for the manager, therefore, managerial decision-making judgement is an integral component throughout the decision-making process (23:19-20).

Donnelly, Gibson and Ivancevich make further clarifications as follow:

Decision support systems have one primary purpose:

-to provide the manager with the necessary information for making intelligent decisions. The critical point here is that not just any information will do. A system is needed that converts raw data into information that management can actually use (7:592).

-In short, an MIS provides information, but a DSS shapes that information to management's needs (7:593).

-A management information system is a decision support system if and only if, it is designed with the primary objectives of managerial support. Thus a DSS is an MIS, but an MIS is not necessarily a DSS (7:603).

BEAMS

The Base Engineer Automated Management System (BEAMS) is currently in use at all base level Civil Engineering organizations. In so far as the Chief of Design is concerned, BEAMS is of little value for direct use as a day to day management tool. BEAMS was not designed with that capability in mind. Although it can be used to output a rudimentary design schedule and accomplish limited manhour tracking, inherent capability limitations have prohibited its growth into an easily accessible, user friendly, management system for the Chief of Design. In short, the BEAMS was not designed with the goal of

providing a Chief of Design with immediate desk top access and other modern computer capabilities that he needs to assist in the efficient accomplishment of the mission.

Current Desktop Computer Systems

A variety of desktop computer systems are in use in Air Force Civil Engineering design offices, most notably the Zenith 100. At present, there does not appear to be an Air Force wide plan to provide a menu of standard hardware or software for use with these systems that is specifically aimed at the management needs of the Chief of Design. Some of the design offices that have acquired computer hardware are using commercially available software such as PFS and VISI CALC with moderate success. Emphasis of use appears to be word processing, which is not addressed in this thesis, and design schedule management.

Work Information Management System Computer (WIMS)

The Air Force is in the process of developing and purchasing the WIMS computer system for use by base level Civil Engineering (CE) organizations. Capt Spillers, whose office at Headquarters Air Force Engineering and Services Center (HQ AFESC) is the focal point for WIMS development, confirmed that there is no written information available to describe WIMS (27). The WIMS is "self-instructional," which means that no written teaching materials are considered necessary (29). The user must learn about the

system by using it. Basically WIMS is designed to provide Electronic Data Processing and serve as a Management Information System.

Mr. Robert L. Reed, Acting Chief of the WIMS Office at Tinker AFB, Oklahoma, and one of WIMS's principle developers, advised that, with respect to its design office functions, WIMS is task oriented toward managing a design schedule and manhour reporting. He added that the basic WIMS program package can be manipulated easily to develop additional programs and new features for existing programs as desired (24).

Maj Timothy Beally, who is on the AFIT Civil Engineering School faculty, pointed out that compilers for the following languages are available on the prototype WIMS: Assembler, Basic, Cobol, Fortran, PL I, and RPG II (3). Using these languages, he has been able to create a variety of user friendly programs. As of January, 1985, the following bases each have a complete prototype WIMS in operation: Edwards, Kirtland, Misawa, Tinker, Hickam, and the USAF Academy (3). It is beyond the scope of this thesis to describe what each base is doing to develop capabilities for the Chief of Design's use in managing his office. Once the Air Force has a firm contract for WIMS, and thus has a specific manufacturer and system selected, the collective experiences of those working on system development plus the input of such sources as this thesis

will be used to design the final design office software for use on WIMS at all bases. WIMS will be developed as a whole to serve all the management computer needs of a typical Air Force Civil Engineering Squadron. Maj Beally pointed out that this development will most likely be coordinated by a Tiger Team (a group of functional experts from various professions including knowledgeable Civil Engineering Design personnel and computer programmers) operating out of the Engineering and Services Center (3). He also pointed out that the software package developed by the Tiger Team for Air Force wide use would use approximately 75 percent of the available capacity by providing Air Force wide desired capabilities. The other 25 percent of the available capacity would be reserved for software created specifically by a particular Civil Engineering organization for their own use (3). In other words, in addition to the canned programs created for Air Force wide use, there will be an additional system capacity available to use for base generated programs. Furthermore, the canned programs may be altered to meet specific base needs. There may be some limitations on what can be altered due to the need to standardize communication formats for interaction between base level computers and command level computers, and for interaction with other computers outside of the Civil Engineering organization.

Maj Beally indicated that WIMS data will be used as an

input for BEAMS. At first, the input will be a tape transfer process. This will later be upgraded to direct electronic access between the two computer systems. BEAMS will remain in use to serve its present functions (3).

Lt Paul McMullin, who participated in WIMS development, said, "Using WIMS for a DSS was not a formal goal, and a DSS has not been built into the system" (19).

Capt Spiliers thinks that WIMS is likely to evolve into a DSS for some bases, but that establishing DSS goals today would unduly complicate the system's acquisition process. He pointed out that the hardware being purchased will be capable of accepting DSS programs without the need for additional software (27).

According to Maj Beally, the Air Force expects to award a contract in March 1986, with an estimated first delivery to bases in July, 1986 (3). Three years will be required for delivery of the systems to all bases.

The prototype WIMS computers were made by Wang. The vendor of the final WIMS contract has not been selected. This may have some effect on the overall system capabilities.

DSS Examples and Problems

The concepts of EDP and MIS have been an integral part of Civil Engineering systems for many years. These concepts do not require further elaboration, but the concept of DSS needs illustration. The following examples

of DSS will give the reader a better understanding of potential uses of DSS by the Air Force.

David Farwell describes a DSS that can be used to design a ski area. He uses a computer to iterate a variety of models which juggle such variables as skier skill levels, ski slope gradients, widths of trails, lift system layouts, and total numbers of skiers, to arrive at an optimum design for a ski area. Basically, he sets up a skier processing system and then changes one or more of the variables. The computer gives him meaningful feedback about the effects the changes have on the system. He can then adjust the system to function more efficiently and iterate through other variable changes to test their effects (8:79-86). Similar models could be designed to help solve Air Force design problems. An example might be developing a model to optimize the design of the mechanical systems in a large building.

Dr. Chan describes how a DSS can be used to design the physical components of an EDP computer (4:17-25). His article is an excellent example of how to manage the manpower components of a major engineering design effort. He discusses computerized scheduling techniques and is concerned with optimization of schedules. His process is very detailed and involves a complex network analysis. "The . . . procedure applies equally well to other types of organizations such as . . . engineering consulting firms"

(4:24). This process could be used to manage Air Force construction projects.

Merle Martin shows how a DSS can be used to manage a jury selection process for a court (20:15-21). According to him,

> -the DSS is impaled on the same spear as (is) the MIS. That spear is the question of what information a manager needs in order to make effective decisions (20:14).
>
> -The starting point in designing Decision Support Systems is to identify pertinent decisions. . . These decisions are divided into sub-decisions at the operational, tactical and strategic levels of management. Once these sub-decisions are isolated, data elements are identified by observation, interview, deduction or a combination of the three (20:21).

The hierarchy of information flow that Martin describes is comparable to the Air Force management hierarchy. His assertion that different managers at different levels need different information is significant.

A variety of problems is associated with DSS implementation, and there is a concern for identifying just what information a DSS should provide. Robert Donnelly says,

> The wrong approach to introducing a DSS is to ask senior management what they want because they usually don't know. . . . In many companies, senior management doesn't know as much as they think they do (28:39).

Similar concerns are voiced by others. According to Carol Thiel, selling a DSS to the hierarchy of management and getting them to accept it and trust it is a big consideration (28:38-44). Larry Meador makes the following

recommendation:

> 1) Tailor the system to the specific tasks and decision-making styles of those who will be using it. 2) Before building a full scale DSS, experiment with small-scale low cost 'demonstration prototypes.' 3) Rely on advanced flexible software technology that will allow the DSS to be modified and updated easily (10:4- 5).

Design Office Productivity Studies

The Air Force does not have an official system for measuring design productivity and has no formal policy as to what form a system might take. Because it is not a profit oriented organization, we cannot simply compare dollar inputs to profit as a productivity measurement. Instead not-for-profit organizations are usually measured on the basis of more subjective parameters. Those measures are hard to define and analyze.

Kaneda and Wallett, in their AFIT thesis, *Development of Productivity Measures for the Design Section of a Base Level Civil Engineering Organization*, define productivity as,

> the measure of the effective and efficient use of resources to attain results which are directed towards achieving the strategic level of organizational goals, through the branch level objectives. Productivity will be measured as a ratio of output to input (14 :13).

They quoted a previous AFIT thesis by Baumgartel and Johnson: "productivity measurement would be accomplished at the organizational and branch levels, and would not be applicable to individual work productivity" (14:21).

Kaneda and Wallett found that there was a "present insufficiency of output measures" (14:28) and "managers are apprehensive about developing and using these measures" (14:77). They also observed that,

> Managers would prefer to tailor productivity measurement on their own and keep information at a local level. . . Each base design section works in an environment (both external and internal) which is different from other design sections. This fact gives credence to the belief that productivity measurement should be kept at the base level and not formalized into a MAJCOM/USAF controlled program (14:78).

Kaneda and Wallett found that at many bases there was no data base for productivity measurement and concluded that the best way to develop a data base might be by using computers to record and analyze data (14).

Moss, Meister, and Ruschmann observed that,

> An Air Force wide program to standardize design manhour estimating procedures could present serious problems. The apparent variability between bases prohibits a set of all-encompassing rules. . . . Only general guidelines may be acceptable. This would allow each base to tailor the estimating procedures to the particular circumstances at that base (22:66-67).

They recommended that, "a comprehensive data base can be created to allow for future research into design management" (22:70).

In a more recent thesis, Astin and Ruff concluded that productivity measurement in a Civil Engineering Design Section was possible and practical. They concluded that it could be done using Constrained Factor Analysis (CFA); and through the use of a CFA computer model to test their theory, they were able to come up with what appears to be

an acceptable methodology. After attempting to measure a variety of inputs and outputs to the computer model, they found that present technology would enable them to take the following listed inputs and outputs and effectively measure productivity in a practicable manner.

<u>Inputs</u>

1. Labor manhours
2. Labor costs
3. Years experience
4. Personnel skill level

<u>Outputs</u>

1. Total contract funds obligated
2. Estimated dollar amount of all projects designed (complete and ready for contracting action)
3. Total O&M maintenance and repair project funds obligated
4. Total number of projects designed (complete and ready for contracting action)
5. One over total funds expensed on contract change orders [reciprocal of total funds expensed]
6. One over number of contract change orders [reciprocal of number of change orders]
7. Total estimated dollar amount of in-house work orders designed
8. Total estimated dollar amount of architect-engineer packages prepared
9. Estimated dollar amount of MCP Project Books
10. Number of work orders reviewed and/or evaluated
11. Number of technical reviews accomplished on designed projects (1:50-51)

Astin and Ruff used a computer at the University of Texas at Austin, to run their model program. The program was written in Fortran.(1:46) Unfortunately that computer capability is not presently available to the rest of the Air Force, which makes further experimentation and useful application impractical at present. Conceivably it could

be transferred to the Air Force in the future. This is the most promising attempt to measure productivity in a Base Civil Engineering Design Section, that the authors have found.

In 1983, while Chief of Design at Lowry Air Force Base, one of the authors, Mr Miller, attempted to develop a historical data base for productivity measurement by recording the number of hours worked on each design project by each design discipline versus the number of hours predicted as necessary to complete each project. This data was needed to measure and predict one aspect of individual and section productivity. Unfortunately, the organization had no EDP capability available and had to postpone the project because it could not afford the time required to compile the necessary data manually. That effort was not nearly as sophisticated as the thesis work discussed above, but it would have been useful at a more primitive level of analysis. The inability to complete such a basic analysis points out the need for the EDP capabilities of WIMS to help in developing a data base for analysis. If a design chief could predict productivity using such a data base, his predictions would be more credible to his superiors. This would allow them to make more intelligent decisions in a large variety of situations, and would amount to using WIMS as a DSS. WIMS should provide some of that capability.

Computer Aided Drafting and Design (CAD)

D.F. Sheldon lists the tasks involved in this aspect of computer operations as follows: "CAD: design, analysis, synthesis, perform calculations, draughting, detail and assembly drawing, drawing updating and filing, cataloguing, parts listing" (26:173). He points out that "the interactive graphics terminal (visual display unit) linked to a computer can now replace the draughting machine as a tool for producing working drawings" (26:174). "For a CAD system of the mini-superminicomputer type, productivity gains varying from 2 to 4:1 can be achieved after a four to six month learning programme" (26:179). Sheldon does not discuss the possibility of using the same computer for Computer Aided Drafting and Design, Electronic Data Processing, Management Information Systems, or Decision Support Systems.

Capt Roberts, in his AFIT thesis entitled Automated Drafting and Design for the Base Civil Engineer, concluded that

> The best interactive graphics system for the BCE would appear to be a turn-key system with all the hardware and software in one package. . . . Depending on the application, productivity increases can be three hundred to fifteen hundred percent (25:45).

Capt Roberts made no mention of using the Computer Aided Drafting and Design system in an Electronic Data Processing, Decision Support System, or Management Information System role.

Lt McMullin said, "When WIMS was first conceptualized, CAD could not be tied into WIMS and still meet budget requirements. So, obtaining CAD systems for the Air Force is now a totally separate issue from WIMS" (19).

When asked if he knew of any effort to tie other computer activities to CAD, Capt Spillers said "We are working an IGS, that is Innovative Graphics System, for [input to the] POM [Program Objective Memorandum] for CAD. As presently planned, CAD will include comprehensive planning, and will integrate data processing, word processing, and graphics" (27). He did not know of any worthwhile written information on the subject. He described a test program for the Air Training Command (ATC) bases in the San Antonio area which will be the Air Force pilot program for CAD. Capt Spillers said, "AFLC [Air Force Logistics Command] has completed a feasibility study at its bases and [it] proved that CAD was cost effective" (27). Maj Beally speculates that an Air Force Civil Engineering CAD system will not be funded until the time frame of the 1988 to 1992 POM.

Summary

The concepts of EDP and MIS are not new to the Air Force. The WIMS will update EDP and provide a MIS for the Base Civil Engineer. No DSS functions are planned for WIMS at present but it is likely that some bases will gravitate towards a DSS use of the WIMS computers after

they obtain them. The WIMS will have the hardware to support a DSS but no programs to do so.

It would be desirable to have WIMS function in a DSS role for a variety of reasons. A DSS could be used to assist individual designers on the designs of their projects, to aid the design chief in management at his level, to provide information to other managers at the same level, and to keep higher level managers informed about important aspects of projects in which they have interest.

There is a common desire to acquire a way to measure Air Force Civil Engineering Design Section productivity. No one has established a commonly accepted way to measure that productivity, but it has been suggested that a historical data base is necessary to use as a standard for comparison. Astin and Ruff believe that the use of Constrained Factor analysis is an effective and comprehensive approach to measure design office productivity, but the facilities to do it are not presently available to the Base Civil Engineers. According to Mr. Reed, the WIMS computer will be able to compile the data that is needed for productivity measurement (24). Exactly how far the people using the system can go to create intelligent productivity measuring programs remains to be seen.

It seems appropriate that each base develop its own forms of Civil Engineering Design Section management.

Because the Air Force has limited experience with DSS, it is not reasonable to assume that each base will learn to use WIMS effectively in that role. Guidance from a group of experts might be appropriate. Further research into the DSS capabilities of WIMS and the needs of its users is needed. The DSS potential of WIMS is currently being neglected in favor of higher priority aspects of system acquisition.

The Air Force plans to start delivery of WIMS to bases in July, 1986. The basic package will provide both EDP and MIS capabilities. No DSS role has been planned. The Air Force plans to obtain CAD after WIMS is operational. CAD will include word processing and graphics capabilities. The CAD concept is in a development stage. Based on present plans, CAD will be compatible with WIMS. It seems appropriate to delay further study of tying CAD and WIMS together until the exact capabilities of each system, as purchased for the Air Force, are known.

III. METHODOLOGY

Review of Research Objectives

The objective of this research was to identify the computer capabilities desired by the Chief of Design at an Air Force base level Civil Engineering Organization for use in carrying out his job responsibilities. The authors anticipate that the results of this thesis may be used as part of a subsequent thesis and/or for direct utilization by persons actively developing computer systems for Civil Engineering design sections.

Research Design

The research design involved several steps. First was the identification of the population and the sample size required. Next it was necessary to create a survey to obtain data. This involved formulation of a presurvey; conducting the presurvey; and finally revising the presurvey based upon inputs from the presurvey respondents. The last step of research was conducting the survey itself.

Population and Sample. The first step in the research design was to contact the Manpower and Personnel Center (MPC) to identify all design sections at CONUS Air Force bases. The study was limited to CONUS bases because of the academic time limitations faced by the authors. It was determined that it would be feasible to sample the entire CONUS population of design sections.

Survey Design. A mailed survey was selected over a telephone survey because of practicality. The survey was too extensive to fill out over the telephone. Questions for the survey were generated from a detailed analysis of the day to day management tasks performed by the Chief of Engineering Design. Both of the authors have experience at that job and were able to generate numerous ideas based upon that experience. Conversations with such people as Maj Timothy Beally and Capt Jeffrey Charles, from the AFIT Civil Engineering School; with faculty members teaching the AFIT Graduate Engineering Management Program; and with fellow students in the program contributed more ideas and helped refine and clarify the scope of the questionnaire. The initial draft survey was rewritten several times to condense information, simplify the logic, and make it easy to answer. Ideas were grouped into general areas that were directly related. An answer sheet that could be read directly by a computer was rejected in favor of filling in the answers directly on the questionnaire. The authors wanted to make it easy to fill in answers in the hope that more questionnaires would be returned instead of being rejected by the respondents as too inconvenient to complete.

Serious consideration was given to asking respondents to rank order the various ideas expressed in the questionnaire. That idea was rejected because it

would make the questionnaire too difficult and time consuming. Instead, respondents were asked to choose between four levels of usefulness, ranging from "Very Useful" to "Not Useful," with a 5th option of "No Opinion". This rating system would allow for prioritizing the ideas based on the total number of responses in each level of usefulness for each question. Relative priorities are important to help establish the order in which to direct limited resources towards the most useful computer capabilities for the Chief of Design.

Two major categories of questions were developed on the questionnaire. The first category dealt specifically with desired computer capabilities for the Chief of Design. This category of questions was broken into several subgroups based upon similar tasks and purposes (see Appendix B, questions 1 through 74). A second category of questions dealt with demographic data describing the respondents (see Appendix B, questions 75 through 98). The demographic questions enabled the authors to determine groups of respondents which could be compared to one another for differences of opinion with respect to the first 74 questions. No specific groups were determined at this stage of the thesis. It was theorized that experimentation with different groups might point out different responses for each group. Therefore a variety of demographic questions were asked which would help define a

variety of groups. In addition to the two major categories of questions, respondents were encouraged to write in their own comments and ideas and an additional "Remarks" sheet was attached to the end of the questionnaire to make it easy for the respondents to express themselves.

Presurvey. A presurvey was used to test the questions for the actual survey. The presurvey also included space for remarks to ensure optimum input and freedom to comment. Recipients of the presurvey were encouraged to add their own individual ideas. The recipients were fellow students, instructors at the School of Systems and Logistics, and instructors and students at the School of Civil Engineering. The criticisms and comments received from the presurvey were used to develop the survey. After examining the ideas and criticisms from the presurvey, it was decided that the final survey should be broken into individually numbered sections, each section being independently numbered, so that the total number of questions would not be clear and turn away respondents.

Survey. All CONUS Air Force bases were selected to receive the survey. The survey included all items determined to be valid through the presurvey. A copy of the survey is included as Appendix B: Questionnaire. Both the Chief of Engineering Design and his immediate supervisor, the Chief of Engineering and Environmental Planning at each CONUS base, were sent questionnaires.

Data Collection

The results from the survey constituted the data for this research. Of the 175 survey questionnaires sent out, 105 were returned. The return rate was 60 percent. Approximately 50 percent of those who responded wrote comments expressing their opinions. Those comments are listed in Appendix G: Questionnaire Remarks.

Data Analysis

A decision was made to analyze the data using the Statistical Package for the Social Sciences (SPSS) on the AFIT Harris computer. Items that were to be examined included frequency of response, possible prioritization of desired capabilities, and correlations and differences between responses based upon groupings of respondents. The grouping of respondents would be based upon such demographic factors as base size, experience, and job description. Two questionnaires were discarded because they were filled out by persons to whom they were not addressed and who did not have sufficient expertise to give meaningful responses. One questionnaire was discarded because the manner in which it was filled out was illogical. Several surveys were returned unanswered. In the end, 96 valid responses to the survey were received in time to be used as data inputs for this thesis.

IV. Findings and Results

Computer Analysis

The data from the respondents was manually entered into an SPSS "FREQUENCIES" program. The responses to the first 74 questions, which addressed desired computer capabilities, were analyzed for all respondents collectively. Then "SELECT IF" statements were used in the computer program to subdivide the respondents into eight smaller groups and the program was executed for each group. This resulted in an analysis of each of the desired capabilities (questions 1 through 74), from the perspective of a total of nine different categories of respondents. The groups were defined as follows: (Note that the Groups are not necessarily mutually exclusive.)

I. All respondents.

II. Chiefs of Engineering Design only.

III. Chiefs of Engineering and Environmental Planning only.

IV. Both Chiefs of Engineering Design and Chiefs of Engineering and Environmental Planning

V. Only persons with three or more years experience as a design engineer or architect.

VI. Only respondents with three or more years in Air Force Civil Engineering.

VII. Only Chiefs of Design with two or more years of experience as the Chief of Design, and Chiefs of Engineering and Environmental Planning with three or more years of previous experience as the Chief of Engineering Design.

VIII. Only persons from bases with a population of 5600 or less.

IX. Only persons from bases with a population of more than 5600.

The results of all the analyses were manually combined to form Appendix C: Results Table. The values listed concern questions 1 through 74 (Desired Computer Capabilities) and consist of the cumulative percentages for the respective question for that group.

All of the demographic data from the questionnaires (responses to questions 75 through 98) is presented in Appendix F: Demographic Data.

Differences Between Responses

There are no major differences between the responses of the various groups. Direct comparisons can only be made between Group II (Chiefs of Engineering Design only) and Group III (Chief of Engineering and Environmental Planning); and between Group VIII (base population 5600 or less) and Group IX (base population more than 5600); because they are the only groups that are mutually exclusive. The differences between Group II and Group III may be explained by looking at the related leadership atmosphere and management position in the engineering branch, whereas the difference between Group VIII and Group IX may be explained by examining the impact of base size on the Chief of Engineering Design's job.

Leadership Atmosphere Spectrum. Data collection in any

organization can be a tedious, time consuming, and expensive task. The purposes and intentions for collecting data vary considerably --- from "nice to know" to "essential for day to day operations." The leadership atmosphere in any organization has a significant influence on the types of data collected and the uses for that data. The leadership atmosphere can be viewed as being on a spectrum between two extremes. At one extreme is the ideal situation where appropriate authority is delegated to each manager. Each manager in turn has the ability, resources, and time necessary to accomplish the task in a timely and intelligent manner. Minor emergencies and urgent projects are assimilated into the management system and processed effectively. Managers from levels above the immediate organization (for example the squadron) do not levy unreasonable requests upon the workers and the workers perform their tasks in a calm management atmosphere with only minor management by exception from managers above the immediate organization.

The other extreme of the leadership atmosphere spectrum will be referred to as the micromanagement situation. In this situation, all the members of the organization are bombarded with urgent emergency projects in somewhat illogical fashions. The volume of work requested is beyond the available ability, resource, and time constraints. Priorities are constantly changing and work is not done in

an effective manner. Managers at levels higher than the immediate organization attempt to manage all levels of the organization themselves. They regularly interrupt the work schedules of all personnel. Little authority is delegated to the lower level managers. The lower level managers are mainly working as data collectors and reporters and have very little time left to work as managers. Most of their time is spent letting others know what is happening as opposed to making the right things happen. Upper level managers perceive perfect reporting to be the most important function of the lower level managers. The point is that the micromanagement situation is extremely poor management. Unfortunately, the micromanagement leadership atmosphere exists to a degree in some organizations, and Civil Engineering is no exception.

Some of the comments on the questionnaires indicate tendencies toward one end or the other of the leadership spectrum. Other managers with whom the authors have discussed this idea agree. The need for some of the desired computer capabilities depends upon the leadership atmosphere at each specific base and even within each specific squadron or engineering branch.

Naturally if a manager works in a leadership situation toward the ideal end of the spectrum, his desired computer capabilities will gravitate toward managing his own office and will have much less emphasis on reporting to the higher

levels of his chain of command. Of course, some reporting is appropriate. Conversely, if a manager works in a leadership situation towards the micromanagement end of the spectrum, he will be more interested in computer capabilities which readily allow him to communicate data up his chain of command. All managers will need some of the capabilities identified in this thesis to manage their offices. Only those managers who operate near the micromanagement end of the spectrum would bother with other capabilities and only because someone up their chain of command directs them to report the information involved.

The leadership atmosphere at each base may have contributed to the desire for some computer capabilities. If so, the capabilities desired by all bases would appear higher on the priority lists than those that are mainly desired at bases where the leadership atmosphere needs improvement.

Management Position. Of all respondents, 91.2% were either the Chief of Engineering Design or the Chief Engineer/Chief of Engineering and Environmental Planning. The need for some of the desired capabilities depends upon which of these two main job categories the respondents work in. There may be a tendency for the Chiefs of Design to place more emphasis on computer capabilities that enable better management of their Design Section and to place less importance on those capabilities that are oriented towards

reporting to their superiors. Conversely, as the supervisor of the Chief of Design, the Chief Engineer is interested in managing the Chief of Design as well as the rest of the Engineering Branch, and he is one step higher on the chain of command. This may slant his preferences more towards reporting capabilities for the branch with less emphasis on first line supervision capabilities for the Chief of Design. Of the 47 Chief Engineers who responded to the questionnaire, 66.7 percent have also worked as the Chief of Engineering Design. Based on total experience, they may have a more complete understanding of what a data management system needs to do. Also consider that the Chief of Design should be highly knowledgeable about most of the needs of his branch. His responses should tend to reflect a concern for interacting with them as well as with the rest of the squadron and his chain of command. Some of the remarks listed in Appendix G reflect such a concern. Upon examination of the responses for the two groups, there is a strong tendency for them to agree. It may be that the two Groups recognize the need for and agree upon most desired capabilities because of their common goals and that the differences between them can be largely explained directly by their different positions in the reporting hierarchy.

Base Size. Base population has a direct impact upon the Engineering Design Section. Some possible impacts are

the number of projects in design and the size of the design section. The larger the base, the larger one would expect to see the numbers of projects and of designers. This increase in the number of projects and number of designers will further complicate the Chief of Design's job, primarily by increasing his work load and the number of items that he has to keep track of. This may explain the differences between the responses from bases with populations of 5600 or less (Group VIII) and those with populations larger than 5600 (Group IX), as shown in Appendix C: Results Table.

Priorities

In order to provide some meaningful interpretation of these results, Appendices D and E were prepared. Appendix D: Priorities by "Very Useful," is a priority listing based upon that response received from Group I, which is all respondents collectively. Appendix E: Priorities by "Very Useful" plus "Moderately Useful," is a priority listing based upon those responses and is also from Group I. These priority lists only contain the 74 computer capabilities that were evaluated by the questionnaire respondents. The additional computer capabilities that were suggested by the respondents in the remarks section of the questionnaire have been included at the end of Appendix D, but they were not included in the priority lists.

These priority listings were developed to provide a

means to focus resources in the development of the computer capabilities. The differences in preferences should be a consideration in determining a relative acquisition priority. The capabilities should generally be developed starting with number 1 and proceeding down the priority list.

Two different priority lists were developed because it is not clear which method was best to use in the prioritization. The authors prefer the list contained in Appendix E: Priorities by "Very Useful" plus "Moderately Useful", because they think that a capability that is rated as either "Very Useful" or "Moderately Useful" should definitely be developed. They also feel that if a significant number of respondents desire a particular capability, then an effort should be made to provide that capability to the work force.

The two lowest priority items on both lists (Appendix D, and Appendix E) are Question 40, Leave computation, and Question 73, Modem for Home Use. With respect to Leave Computation, 68.4 percent of all respondents said that it would be at least "Slightly Useful", 33.7 percent said it would be at least "Moderately Useful", and 22.1 percent said it would be "Very Useful". With respect to a Modem for Home Use, 62.1 percent of all respondents said that it would be at least "Slightly Useful", 36.8 percent said that it would be at least "Moderately Useful", and 21.1 percent

said that it would be "Very Useful". Over 60 percent of all respondents found these lowest rated items to be in one of the "Useful" categories. This suggests that even the lowest rated capabilities examined in this thesis should be provided to the people in the field.

In writing the software programs to provide the desired capabilities toward the top of the lists, the computer programmers are likely to find that with very little additional work or cost they can provide some of the other desired capabilities that fall toward the low ends of the lists. In other words, once a program has been written and the essential data has been entered to support it, entering just a little more data and/or writing just a few more lines of code may provide some lower rated capabilities at little cost. This should be taken into consideration when addressing each questionnaire grouping of capabilities during program development.

Comments About Respondents' Remarks

All of the comments received with returned questionnaires have been compiled as Appendix G. The respondents suggested some new ideas and capabilities, which should be given serious attention. Some of them are obviously desirable, but they were not included in the overall priority lists because selecting priorities for them would be arbitrary. The additional capabilities suggested by the respondents have been listed at the end of

Appendix D. There were several comments received concerning the idea that data collection and input will be a time consuming job. In addition, human nature should be considered. Managers will want certain data to measure the performance of their people. This is true at all levels. If the managers imply that the data will eventually be used as a hammer to punish their employees for less than perfect performance, then the employees will be likely to resist giving data inputs to the system and may distort data in their own favor where possible. Several of the remarks in Appendix G show a concern for obtaining cooperation from employees in obtaining data. Management needs to consider these human factors because they will most likely affect employee morale and the validity of outputs from the computer system.

Some respondents feel that entering manhour data into the computer will be inconvenient and not worth the effort. However, this same information is already being entered into the BEAMS computer to provide information for pay and leave computations. The data is already there and waiting to be used for any appropriate purpose.

With a good data base management system, much of the data that would be useful to the entire Civil Engineering Squadron would only have to be entered into the computer once, by the most appropriate office, and then the data would be automatically available for use by the entire

Squadron. Ideally this will result in less manual data processing and less confusion and mistakes than presently occur, and it will free up more time for managers to do other management chores. The idea is to make the computer do the work!

V. Conclusions and Recommendations

Conclusions

Development of computer support for direct management applications in an Air Force Base Level Civil Engineering Design Section is needed. Until now, a comprehensive list of the desired computer capabilities for such management support had not been developed from the viewpoint of a Chief of Design. This research effort is a step forward in the Air Force effort to provide modern computerized management tools to Base Civil Engineers.

Discussion of Research Objectives

The objectives of this research were, 1) to determine what computer capabilities are required in order for the Chief of Design to do his job, 2) to determine which of these capabilities are the most desirable, and 3) to determine if there is any specialized subgroup of desired capabilities based upon such factors as base size, experience, job description, or similar category. In other words, what computer capabilities should be considered in determining where to focus computer resources and what is the importance of each? The ultimate goal is for this information to be incorporated into the design of computer systems for Civil Engineering.

The priority listings of desired computer capabilities in Appendices D and E constitute the accomplishment of the

first two objectives. However the reader snould examine the remarks from the respondents contained in Appendix G and temper his judgement of those priorities in light of the remarks. With respect to the third objective, it was found that there are no large differences between desired capabilities based upon any factors the authors were able to analyze. Appendix C: Results Table, presents a comparison of nine different groupings of the respondents. Chapter IV, Findings and Results, suggests reasons for the slight differences of opinions found. The research objectives have been accomplished. Copies of this study will be provided to those who will implement its results.

Recommendations

Interviews. *Subsequent researchers* should conduct interviews with some of the respondents to establish if the respondents are in agreement with the priority listings established by this thesis. The research should also address the respondent's opinions about the additional capabilities suggested in the remarks section of the questionnaire.

Leadership. Further research is needed to determine ways in which present management functions can be streamlined and to search for a better way for the Civil Engineers to interact with the rest of a base.

Earlier in this study it was proposed that a leadership atmosphere at a particular base may affect the

perceived need for certain computer capabilities. This concept should be studied with several objectives in mind. First, to determine if it is valid. Then, to see if a methodology can be developed to improve the leadership atmosphere from tendencies toward the micromanagement end of the spectrum to the ideal situation end of the spectrum. In other words, looking both within and external to Civil Engineering, exactly what leadership problems exist and how can management be improved? Is it intelligent and in the best interest of the Air Force to always say "Yes" to any request from above? What can be done to minimize data collection for meaningless reporting? How useful is each report that is created? Would other management techniques be better, and if so, what are they and how can the Air Force transition to their use?

The goals of this research should be to eliminate inefficient reporting and to work smarter. Having the computer give an answer to a trivial question may not be as smart as finding a way to prevent the question from being asked in the first place.

Human Factors. There may be a variety of problems associated with the human aspects of implementing computers in Civil Engineering organizations. Earlier, it was pointed out that there may be a reluctance by some people to enter data into a computer system if that data could later be used to criticize them. Also, some people believe

that collecting and entering data will be too time consuming. Unless the people collecting and entering data see positive managerial feedback and a clear benefit to themselves and to their organization, they may not care about the timeliness or accuracy of the data.

Human factors, such as the ones discussed above, should be considered in developing computer software and in implementing computer systems at each base. Further research is needed to identify as many human factors as possible prior to implementing management information systems in Civil Engineering organizations. The main goal of the research should be to suggest practical ways to avoid anticipated problems and to encourage positive attitudes about implementing and working with computer systems.

Interim Measures. The Air Force plans to develop and procure WIMS for each base level Civil Engineering organization. WIMS will be a giant step forward for the entire organization and it will specifically address the needs of the Chief of Design. However, WIMS will not be purchased until the spring of 1986 and some bases are not scheduled to receive it until 1989. Thus, some bases will not have this improvement in their computer capabilities for several years. Contracting problems could extend these delivery dates even further. Somehow, prior to the implementation of WIMS at all bases, Civil Engineering

leadership should make an effort to provide the bases scheduled to receive WIMS last with some of the more important capabilities required by the Chief of Design. Perhaps, concurrent with the development of WIMS software, the Air Force could develop abbreviated software packages for use by those design sections which already possess desktop computers. Also, when WIMS is implemented at the first bases, the Air Force could take any existing desktop computers from those bases and give them to the bases that are lower on the WIMS delivery list.

Other Managers. The Chief of Engineering Design is only one of several managers in the Engineering Branch of Base Civil Engineering. Although this study did address the Design Section and the Site Development/Drafting Section together, and although it did solicit input from the Chief Engineer/Chief of Engineering and Environmental Planning, it did not address the Engineering Branch as a whole. Thus, the other sections in the branch --- the Environmental Planning Section, the Construction Management Section, and the Real Estate Section --- were not directly considered in the research. The authors recommend that further research address the computer needs of these sections. In addition, future researchers should consider the computer needs of the remainder of the Civil Engineering Squadron and higher levels of the Air Force hierarchy.

Appendix A: Panel Members

Panel of AFIT School of Systems and Logistics

Faculty

NAME/RANK	POSITION
James D. Meadows, GM-13	Professor of Computer Systems Analysis

Panel of AFIT School of Civil Engineering

Faculty

NAME/RANK	POSITION
Jeffrey R. Charles, Captain	Course Director, Dept of Management Applications
Timothy N. Beally, Major	Course Director, Dept of Management Applications

Appendix B: Questionnaire

The questionnaire that follows is similar to the one mailed to the respondents except that the questions have been renumbered in consecutive order for ease of cross reference within the rest of the thesis. The computer capabilities are covered by questions 1 through 74. Questions 75 through 98 were used to obtain demographic information so that the respondents could be divided into subgroups for analysis and comparison.

Applications of a Computer System for the Chief of Design

For the following questions, assume that you and other CE Squadron managers have a management computer system which includes your own desk top terminal, a conveniently located printer, and connections to all other terminals in the CE Squadron. Also assume that each major office in the Squadron has a similar setup.

The following questions are related to capabilities that the computer system might have. Please select a response from the Answer Scale List (shown below) that most nearly describes your opinion of the utility of the feature described as it affects the job of the Chief of Engineering Design. Please place the number corresponding to your response in the space preceding the question.

If you have any comments (pro, con, or otherwise) that you think are pertinent concerning any of the ideas expressed below and if you have any other ideas about the desired capabilities of a management computer system for an engineering design office, please write them down in the remarks section at the end of this questionnaire. They will be greatly appreciated. Please place all answers directly on this questionnaire.

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

I. PERSONAL MANAGEMENT

How useful would it be to have the following capabilities?

1. _____Capability to utilize a thirteen Month Calendar of events showing your own items of interest by day, month or year as appropriate (including such things as important memos, meetings,and deadlines).
2. _____Capability to transmit electronic mail (ability to send messages via the Squadron computer system to other people on the system, which they can either read immediately, if they are on the system, or which they can read when

they turn on their part of the system; with the ability for them to reply to you in a like manner).

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No Opinion

II. DESIGN SCHEDULE AND DERIVATIVES

How useful would it be to have the following capabilities?

Capability to contain the Design Schedule and its derivatives including the following things:

3. ______project number
4. ______project name
5. ______project priority versus all other projects
6. ______EEIC/funds type
7. ______date of 1391 completion
8. ______1391 cost estimates showing Minor Construction (MC), Maintenance (M), Repair (R), & total
9. ______current working estimates by designer showing MC, M, R and total
10. ______percent design complete
11. ______estimated design completion date
12. ______estimated hours to complete design for each engineering discipline
13. ______estimated drafting hours required to complete the project
14. ______name of principal engineer/architect
15. ______names of all engineers/architects involved in the project
16. ______name of A&E if applicable
17. ______key milestone dates of the A&E contract if applicable
18. ______name, office symbol, and phone number of the key person in the using agency
19. ______general notes and comments about each project

In addition to the previous assumptions, for all of the following questions also assume that all input data relevant to the calculations is in the computer.

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

Capability of the system to perform the following functions:

20. _____calculation of number of projects that can be completed with available manhours by a certain date
21. _____calculation of effects of one or more designers working overtime on a specific project's completion date
22. _____calculation of effects of introducing new projects on completion of other projects
23. _____calculation of effects of incorrect initial design time estimates, changes of scope, or other reasons for project delays or accelerations on specific projects and the overall schedule
24. _____calculation of effects of shuffling the relative priorities of projects on project completion dates: straight recalculation of completion dates without concern for inefficiencies generated
25. _____calculation of effects of losing key personnel on total number of projects that can be completed by a certain date (both permanent and temporary loss)
26. _____calculation of effects of indirect labor (for example: sick leave, TDY, etc.) versus total manhours available and project completion dates
27. _____all calculations to be made both on the basis of total manhours available by discipline and also if desired by specific people against specific projects
28. _____automatic listing of projects by any of the following:
    - overall priority
    - EEIC/funding category priority
    - individual designer priority
    - design discipline priority

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

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29. _____selective listing of special interest projects and selective data on each of these for briefings etc.
30. _____selective listing of projects and selected data on those projects by using agency key personnel name and/or office symbol
31. _____listing of selective data on all projects or any EEIC grouping of projects or any similar selected group of projects for briefings etc.
32. _____calculation of percentage completion of the overall schedule for a given time period (for example by quarter of the fiscal year) and the same by subgrouping such as EEIC; all compared to scheduled percentage completion or similar goals and then graphed for easy analysis
33. _____print any data on viewgraph slide format directly or indirectly

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III. <u>TOTAL WORK SCHEDULE AND DERIVATIVES</u>

Capability of the system to contain the following information on each person in the design section in the area of <u>Personnel Management</u>:

34. _____individual project assignments and tasks by priority with the capability to update by interaction with individual on basis of accomplishment of tasks and his recommendations as to what should be done next in conjunction with approval of chief of design

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

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35. _____record of training and schools attended
36. _____additional duties
37. _____committee memberships and similar activities
38. _____individual listing of scheduled leave, TDY, training, schools, and similar absences from the section
39. _____individual listing of significant calendar events such as meetings, A&E boards, etc.

Capability of the system to take the input from daily time sheets and use this information to accomplish <u>Manhour accounting</u> for the following purposes:

40. _____for pay and leave computations (including automatic calculation of leave entitlement versus leave taken, use or lose calculation, and similar records)
41. _____for record of overtime
42. _____for productivity measurement (individually and collectively)
43. _____for historical records to aid in future time estimating, predicting productivity, need for overtime and similar uses
44. _____by specific person vs total time worked on specific projects and specific assigned tasks
45. _____by specific project vs original estimates
46. _____for use in updating the design schedule and the total work schedule by automatic recalculation of estimated completion dates based on time spent on a project vs time estimated
47. _____to include scheduling of leave, TDY's, schools, training, military exercises and other activities causing absence of personnel from the design section
48. _____with automatic calculation of the effects of the absences listed in the question above on total manhour availability and individual designer availability vs work schedule projects and task completion and with these absences further reflected in the

design schedule

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

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49. _____with all this automatically shown on a calendar of events that can be easily called up and which takes into account holidays and similar events in calculating all manpower projections.
50. _____All manpower projections to be based on actual calendar, considering holidays, and lengths of months, and not on theoretical 30 day months.
51. _____All this to directly be input to the total work schedule and design schedule

Capability of the system to assist in Work Request Management by having the following abilities with respect to work requests in the design section:

52. _____ability to retrieve by work request number
53. _____ability to retrieve by facility number
54. _____ability to retrieve along with all other projects in the design section by key using agency personnel name
55. _____ability to list work requests and selected data about each by name of person in charge of them in the design office

Ability to store the following information on each work request that is in the design section:

56. _____person in charge of each work request
57. _____estimated time required to complete the work request
58. _____priority relative to all other work in the office
59. _____priority relative to all other work for that person
60. _____estimated completion date
61. _____general comments about it

Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

IV. ARCHITECTURAL ENGINEERING FIRM MANAGEMENT

Capability of the system to assist in A&E Management by containing the following information:

62. _____A&E board dates & members in A&E selection process
63. _____listing of all projects assigned to a specific A&E and all information about each project from the design schedule
64. _____reminders of scheduled due dates and actual accomplishment dates for all A&E submittals and government reviews
65. _____percent of projects completed vs scheduled to be complete
66. _____general notes on A&E performance

V. MCP MANAGEMENT

Capability to assist in MCP Management by storing the following information:

67. _____information on each project similar to the information contained in the design schedule, including names and phone numbers of key personnel from the Corps, the using agencies, and any A&E firms involved with a schedule of significant milestones

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Answer Scale List:

1. Very useful
2. Moderately useful
3. Slightly useful
4. Not useful
5. No opinion

VI. <u>DRAFTING SECTION MANAGEMENT</u>

Capability to assist in <u>Drafting Section Management</u> by containing the following information:

68. _____overall drafting section work priorities
69. _____records of drawing updates
    date received information about
    date scheduled
    date accomplished
70. _____supplies for the engineering branch
    date received information about and requestor
    date ordered
    date received
    an overall supply tracking system
71. _____site surveys
    date received information about requirement
    date scheduled
    date completed
72. _____digging permits
    date requested
    date completed

VII. <u>TELEPHONE MODEM</u>

Need for a telephone line computer connection to another computer (a modem):

73. _____capability to use it to work from home with your own personal computer
74. _____capability to use it to connect to contract computer services such as a master specification file or similar service if the service were available? If you know of any such service that you would like to use,

would you please identify it in the remarks section that follows.

VIII. DEMOGRAPHIC INFORMATION

For the following questions, please circle the letter that corresponds to your desired answer.

75. What is your age in years?

a. 21-25	c. 31-35	e. 41-45
b. 26-30	d. 36-40	f. 46 & above

76. What is your engineering discipline?

a. Architect
b. Civil
c. Mechanical
d. Electrical
e. Other, please specify ______________________________.

77. What is your highest education level?

a. B.S. Degree	c. Master's Degree
b. B.S. + some graduate work	d. Master's +

78. What is your present job title?

a. Chief of Engineering Design
b. Chief of Engineering and Environmental
c. Other, please specify ____________________________.

79. How long have you worked in your present job (to the nearest year)?

a. 0-1	c. 4-5
b. 2-3	d. more than 5 years

80. <u>Answer this question only if you are not presently the Chief of Engineering Design.</u> In the past, how long did you work as a Chief of Design?

a. no time worked
b. less than 1 year
c. 1 but less than 3 years
d. 3 but less than 5 years
e. 5 or more years

81. How long have you worked as a design engineer or architect?

a. no time worked
b. less than 1 year
c. 1 but less than 3 years
d. 3 but less than 5 years
e. 5 or more years

82. How long have you worked as a design engineer or architect for the Air Force?

a. no time worked
b. less than 1 year
c. 1 but less than 3 years
d. 3 but less than 5 years
e. 5 or more years

83. How long have you worked in Air Force Civil Engineering?

a. no time worked
b. less than 1 year
c. 1 but less than 3 years
d. 3 but less than 5 years
e. 5 or more years

84. How long have you worked for your current Major Air Command?

a. no time worked
b. less than 1 year
c. 1 but less than 3 years
d. 3 but less than 5 years
e. 5 or more years

85. What Major Air Command do you work for?

please fill in ________________________.

86. Approximately how many people (total military and civilian) work in your squadron?

please fill in ________________________.

87. Approximately how many people (total military and civilian) work on your base?

please fill in________________________.

How many people (including technicians) do you have working in each of the following disciplines in your design section? (please fill in)

88. Architecture _______

89. Civil ______________

90. Mechanical _________

91. Electrical _______

92. Drafting _________

93. Other ___________

94. In the design section, do you have a lead engineer or architect who is both formally in charge of each discipline and who writes evaluation reports on the others in his discipline?

a. yes b. no

95. Have you ever had any familiarization (or orientation) on the Work Information Management System (WIMS)?

a. yes b. no

96. Do you routinely use a desk top computer system either at work or at home?

a. yes b. no

97. If the answer to the above question was yes, where do you use it? If the answer was no, skip this question.

a. work b. home c. both

98. Have you ever worked with a Management Information System or Decision Support System? If you do not understand these terms, please answer no to this question.

a. yes b. no

REMARKS:

Please write any comments and ideas that you feel would contribute to the development of a computer management system for use by the Chief of Engineering Design.

Appendix C: Results Table

The tables which follow contain a summation of the data obtained from statistical analyses of the questionnaire responses. The values in the tables are the cumulative percentages for the responses for the respective question for that group.

The groups are defined as follows:

I. All respondents.

II. Chiefs of Engineering Design only.

III. Chiefs of Engineering and Environmental Planning only.

IV. Both Chiefs of Engineering Design and Chiefs of Engineering and Environmental Planning

V. Only persons with three or more years experience as a design engineer or architect.

VI. Only respondents with three or more years in Air Force Civil Engineering.

VII. Only Chiefs of Design with two or more years of experience as the Chief of Design, and Chiefs of Engineering and Environmental Planning with three or more years of previous experience as the Chief of Engineering Design.

VIII. Only persons from bases with a population of 5600 or less.

IX. Only persons from bases with a population of more than 5600.

The five possible responses, with the corresponding definitions, for each question are as follows:

Response	Definition
1	Very Useful
2	Moderately Useful
3	Slightly Useful
4	Not Useful
5	No Opinion

SUMMARY OF RESPONSES FOR ALL GROUPS

(cumulative adjusted percentages)

QUESTION	RESPONSE	GROUP I	II	III	IV	V	VI	VII	VIII	IX
Q1	13 Month Calendar									
	1	46.8	38.5	46.8	43.0	46.8	46.8	37.8	51.1	42.6
	2	75.5	76.9	72.3	74.4	75.5	75.5	73.3	78.7	72.3
	3	94.7	94.9	95.7	95.3	94.7	94.7	93.3	93.6	95.7
	4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	5									
Q2	Electronic Mail									
	1	42.6	25.6	53.2	40.7	42.6	42.6	40.0	36.2	48.9
	2	73.4	66.7	78.7	73.3	73.4	73.4	71.1	68.1	78.7
	3	93.6	92.3	95.7	94.2	93.6	93.6	95.6	93.6	93.6
	4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	5									
Q3	Project Number									
	1	95.7	97.4	93.5	95.3	95.7	95.7	97.8	100.0	91.5
	2	98.9	97.4	100.0	98.8	98.9	98.9	97.8		97.9
	3	100.0	100.0		100.0	100.0	100.0	100.0		100.0
	4									
	5									
Q4	Project Name									
	1	95.7	97.4	93.5	95.3	95.7	95.7	97.8	100.0	91.5
	2	98.9	97.4	100.0	98.8	98.9	98.9	97.8		97.9
	3	100.0	100.0		100.0	100.0	100.0	100.0		100.0
	4									
	5									
Q5	Project Overall Priority									
	1	85.1	87.2	84.8	85.9	85.1	85.1	93.3	89.4	80.9
	2	96.8	94.9	97.8	96.5	96.8	96.8	95.6	100.0	93.6
	3	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0
	4									
	5									

Q6 EEIC Funds Type

	I	II	III	IV	V	VI	VII	VIII	IX
1	78.7	76.9	82.6	80.0	78.7	78.7	86.7	83.0	74.5
2	92.6	92.3	93.5	92.9	92.6	92.6	95.6	97.9	87.2
3	98.9	100.0	100.0	100.0	98.9	98.9	100.0	100.0	97.9
4	100.0				100.0	100.0			100.0
5									

Q7 Date of 1391 Completion

	I	II	III	IV	V	VI	VII	VIII	IX
1	52.1	38.5	60.9	50.6	52.1	52.1	51.1	53.2	51.1
2	75.5	64.1	82.6	74.1	75.5	75.5	71.1	78.7	72.3
3	96.8	92.3	100.0	96.5	96.8	96.8	97.8	100.0	93.6
4	98.9	97.4		98.8	98.9	98.9	100.0		97.9
5	100.0	100.0		100.0	100.0	100.0			100.0

Q8 1391 Cost Estimates

	I	II	III	IV	V	VI	VII	VIII	IX
1	72.3	69.2	73.9	71.8	72.3	72.3	73.3	76.6	68.1
2	95.7	94.9	95.7	95.3	95.7	95.7	95.6	97.9	93.6
3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4									
5									

Q9 Current Working Cost Estimates

	I	II	III	IV	V	VI	VII	VIII	IX
1	79.8	79.5	80.4	80.0	79.8	79.8	77.8	83.0	76.6
2	92.6	87.2	95.7	91.8	92.6	92.6	88.9	91.5	93.6
3	96.8	94.9	97.8	96.5	96.8	96.8	95.6	95.7	97.9
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q10 Percent Design Complete

	I	II	III	IV	V	VI	VII	VIII	IX
1	88.3	92.3	84.8	88.2	88.3	88.3	86.7	95.7	80.9
2	98.9	97.4	100.0	98.8	98.9	98.9	97.8	100.0	97.9
3	100.0	100.0		100.0	100.0	100.0	100.0		100.0
4									
5									

Q11 Estimated Design Completion Date

	I	II	III	IV	V	VI	VII	VIII	IX
1	86.2	89.7	87.0	88.2	86.2	86.2	86.7	89.4	83.0
2	95.7	94.9	95.7	95.3	95.7	95.7	93.3	97.9	93.6
3	98.9	97.4	100.0	98.8	98.9	98.9	97.8	97.9	100.0
4	100.0	100.0		100.0	100.0	100.0	100.0	100.0	
5									

	I	II	III	IV	V	VI	VII	VIII	IX
Q12 Est. Hrs. to Comp. by Discipline									
1	50.0	46.2	56.5	51.8	50.0	50.0	53.3	48.9	51.1
2	80.9	82.1	82.6	82.4	80.9	80.9	82.2	85.1	76.6
3	94.7	97.4	93.5	95.3	94.7	94.7	97.8	95.7	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									
Q13 Est. of Drafting Hrs. to Comp.									
1	44.7	41.0	47.8	44.7	44.7	44.7	46.7	42.6	46.8
2	75.5	71.8	82.6	77.6	75.5	75.5	77.8	80.9	70.2
3	87.2	87.2	89.1	88.2	87.2	87.2	93.3	91.5	83.0
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									
Q14 Name of Project Arch. or Engr.									
1	84.0	89.7	82.6	85.9	84.0	84.0	86.7	91.5	76.6
2	93.6	97.4	93.5	95.3	93.6	93.6	95.6	97.9	89.4
3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4									
5									
Q15 Names of all Archs. and Engrs.									
1	46.2	46.2	47.7	47.0	46.7	46.7	43.2	45.7	47.8
2	79.3	82.1	77.3	79.5	79.3	79.3	75.0	76.1	82.6
3	92.4	94.9	90.9	92.8	92.4	92.4	86.4	89.1	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									
Q16 Name of A&E if Applicable									
1	67.0	66.7	67.4	67.1	67.0	67.0	62.2	72.3	61.7
2	84.0	87.2	82.6	84.7	84.0	84.0	82.2	87.2	80.9
3	97.9	94.9	100.0	97.6	97.9	97.9	95.6	100.0	95.7
4	100.0	100.0		100.0	100.0	100.0	100.0		100.0
5									
Q17 A&E Milestone Dates if Applicable									
1	78.7	82.1	76.1	78.8	78.7	78.7	75.6	78.7	78.7
2	91.5	89.7	91.3	90.6	91.5	91.5	86.7	93.6	89.4
3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4									
5									

Q18 Using Agency Point of Contact

	I	II	III	IV	V	VI	VII	VIII	IX
1	59.6	48.7	65.2	57.6	59.6	59.6	57.8	57.4	61.7
2	83.0	82.1	80.4	81.2	83.0	83.0	80.0	87.2	78.7
3	95.7	89.7	100.0	95.3	95.7	95.7	95.6	95.7	95.7
4	100.0	100.0		100.0	100.0	100.0	100.0	100.0	100.0
5									

Q19 General Notes About the Project

	I	II	III	IV	V	VI	VII	VIII	IX
1	51.1	48.7	54.3	51.8	51.1	51.1	44.4	53.2	48.9
2	83.0	82.1	80.4	81.2	83.0	83.0	82.2	83.0	83.0
3	97.9	94.9	100.0	97.6	97.9	97.9	95.6	100.0	95.7
4	97.9	94.9		97.6	97.9	97.9	95.6		95.7
5	100.0	100.0		100.0	100.0	100.0	100.0		100.0

Q20 Calc. of Projects Complete

	I	II	III	IV	V	VI	VII	VIII	IX
1	61.7	61.5	63.0	62.4	61.7	61.7	57.8	61.7	61.7
2	81.9	79.5	84.8	82.4	81.9	81.9	82.2	89.4	74.5
3	91.5	92.3	91.3	91.8	91.5	91.5	91.1	93.6	89.4
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q21 Calc. of overtime on Comp. Date

	I	II	III	IV	V	VI	VII	VIII	IX
1	50.5	45.0	56.5	51.2	50.5	50.5	51.1	47.9	53.2
2	73.7	72.5	78.3	75.6	73.7	73.7	71.1	79.2	68.1
3	87.4	82.5	91.3	87.2	87.4	87.4	86.7	89.6	85.1
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q22 Effects of Introducing New Projects

	I	II	III	IV	V	VI	VII	VIII	IX
1	68.4	65.0	71.7	68.6	68.4	68.4	68.9	64.6	72.3
2	84.2	80.0	89.1	84.9	84.2	84.2	82.2	89.6	78.7
3	93.7	92.5	95.7	94.2	93.7	93.7	93.3	95.8	91.5
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q23 Effects of Project Delays

	I	II	III	IV	V	VI	VII	VIII	IX
1	52.1	51.3	52.2	51.8	52.1	52.1	48.9	52.1	52.2
2	79.8	76.9	82.6	80.0	79.8	79.8	80.0	87.5	71.7
3	92.6	92.3	93.5	92.9	92.6	92.6	95.6	95.8	89.1
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

	I	II	III	IV	V	VI	VII	VIII	IX
Q24	**Effects of Shuffling Priorities**								
1	60.0	55.0	65.2	60.5	60.0	60.0	55.6	62.5	57.4
2	80.0	77.5	82.6	80.2	80.0	80.0	80.0	89.6	70.2
3	91.6	92.5	91.3	91.9	91.6	91.6	95.6	95.8	87.2
4	98.9	100.0	97.8	98.8	98.9	98.9	100.0	100.0	97.9
5	100.0		100.0	100.0	100.0	100.0			100.0
Q25	**Effects of Losing Key People**								
1	58.9	50.0	67.4	59.3	58.9	58.9	57.8	62.5	55.3
2	83.2	80.0	87.0	83.7	83.2	83.2	84.4	87.5	78.7
3	95.8	97.5	95.7	96.5	95.8	95.8	97.8	97.9	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									
Q26	**Effects of Leave, TDY, etc.**								
1	47.4	47.5	47.8	47.7	47.4	47.4	46.7	47.9	46.8
2	82.1	80.0	84.8	82.6	82.1	82.1	82.2	87.5	76.6
3	90.5	92.5	89.1	90.7	90.5	90.5	91.1	91.7	89.4
4	98.9	100.0	97.8	98.8	98.9	98.9	100.0	100.0	97.9
5	100.0		100.0	100.0	100.0	100.0			100.0
Q27	**Hrs. Breakdown by Discipline**								
1	53.7	45.0	63.0	54.7	53.7	53.7	55.6	50.0	57.4
2	74.7	72.5	78.3	75.6	74.7	74.7	77.8	83.3	66.0
3	90.5	92.5	89.1	90.7	90.5	90.5	93.3	91.7	89.4
4	97.9	100.0	95.7	97.7	97.9	97.9	97.8	97.9	97.9
5	100.0		100.0	100.0	100.0	100.0	100.0	100.0	100.0
Q28	**Priorities by Various Categories**								
1	81.1	77.5	87.0	82.6	81.1	81.1	80.0	77.1	85.1
2	95.8	92.5	97.8	95.3	95.8	95.8	95.6	97.9	93.6
3	98.9	100.0	97.8	98.8	98.9	98.9	100.0	100.0	97.9
4	98.9		97.8	98.8	98.9	98.9			97.9
5	100.0		100.0	100.0	100.0	100.0			100.0
Q29	**Selective Listings of Data**								
1	69.5	62.5	76.1	69.8	69.5	69.5	68.9	68.8	70.2
2	88.4	85.0	89.1	87.2	88.4	88.4	86.7	87.5	89.4
3	97.9	95.0	100.0	97.7	97.9	97.9	95.6	97.9	97.9
4	100.0	100.0		100.0	100.0	100.0	100.0	100.0	100.0
5									

Q30 Selective Listings by Agency

	I	II	III	IV	V	VI	VII	VIII	IX
1	40.0	27.5	47.8	38.4	40.0	40.0	31.1	37.5	42.6
2	69.5	60.0	71.7	66.3	69.5	69.5	57.8	72.9	66.0
3	92.6	87.5	95.7	91.9	92.6	92.6	86.7	93.8	91.5
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q31 Data on Select Group of Projects

	I	II	III	IV	V	VI	VII	VIII	IX
1	57.9	47.5	65.2	57.0	57.9	57.9	55.6	58.3	57.4
2	82.1	72.5	87.0	80.2	82.1	82.1	75.6	83.3	80.9
3	97.9	95.0	100.0	97.7	97.9	97.9	95.6	100.0	95.7
4	100.0	100.0		100.0	100.0	100.0	100.0		100.0
5									

Q32 Calc. of % Complete by a Date

	I	II	III	IV	V	VI	VII	VIII	IX
1	63.2	60.0	71.7	66.3	63.2	63.2	61.4	64.6	61.7
2	81.1	77.5	84.8	81.4	81.1	81.1	81.8	85.4	76.6
3	95.8	95.0	97.8	96.5	95.8	95.8	97.7	95.8	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q33 Print Any Data on Viewgraph Slide

	I	II	III	IV	V	VI	VII	VIII	IX
1	77.9	75.0	80.4	77.9	77.9	77.9	77.3	89.6	66.0
2	94.7	92.5	97.5	94.2	94.7	94.7	93.2	97.9	91.5
3	98.9	97.5	100.0	98.8	98.9	98.9	97.7	100.0	97.9
4	100.0	100.0		100.0	100.0	100.0	100.0		100.0
5									

Q34 Individual Work Assignments

	I	II	III	IV	V	VI	VII	VIII	IX
1	66.3	62.5	67.4	65.1	66.3	66.3	68.2	68.8	63.8
2	88.4	87.5	89.1	88.4	88.4	88.4	88.6	87.5	89.4
3	95.8	92.5	97.8	95.3	95.8	95.8	95.5	93.8	97.9
4	98.9	97.5	100.0	98.8	98.9	98.9	100.0	97.9	100.0
5	100.0	100.0		100.0	100.0	100.0		100.0	

Q35 Record of Past Training and Ed.

	I	II	III	IV	V	VI	VII	VIII	IX
1	41.1	35.0	43.5	39.5	41.1	41.1	45.5	47.9	34.0
2	70.5	65.0	73.9	69.8	70.5	70.5	70.5	68.8	72.3
3	93.7	92.5	95.7	94.2	93.7	93.7	95.5	91.7	95.7
4	97.9	97.5	97.8	97.7	97.9	97.9	100.0	95.8	100.0
5	100.0	100.0	100.0	100.0	100.0	100.0		100.0	

Q36 Listing of Additional Duties

	I	II	III	IV	V	VI	VII	VIII	IX
1	41.1	35.0	39.1	37.2	41.1	41.1	43.2	43.8	38.3
2	68.4	62.5	71.7	67.4	68.4	68.4	68.2	70.8	66.0
3	95.8	95.0	97.8	96.5	95.8	95.8	95.5	95.8	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q37 List of Committee Memberships

	I	II	III	IV	V	VI	VII	VIII	IX
1	31.6	25.0	32.6	29.1	31.6	31.6	31.8	37.5	25.5
2	57.9	55.0	58.7	57.0	57.9	57.9	59.1	62.5	53.2
3	92.6	92.5	93.5	93.0	92.6	92.6	95.5	89.6	95.7
4	98.9	100.0	97.8	98.8	98.9	98.9	100.0	97.9	100.0
5	100.0		100.0	100.0	100.0	100.0		100.0	

Q38 Schedule of Indv. Leave, TDY, etc.

	I	II	III	IV	V	VI	VII	VIII	IX
1	52.1	53.8	52.5	52.9	52.1	52.1	54.5	63.8	40.4
2	79.8	82.1	78.3	80.0	79.8	79.8	84.1	85.1	74.5
3	94.7	97.4	93.5	95.3	94.7	94.7	97.7	93.6	95.7
4	98.9	100.0	100.0	98.8	98.9	98.9	100.0	97.9	100.0
5	100.0			100.0	100.0	100.0		100.0	

Q39 Individual Calendar of Events

	I	II	III	IV	V	VI	VII	VIII	IX
1	45.3	35.0	50.0	43.0	45.3	45.3	45.5	50.0	40.4
2	74.7	70.0	78.3	74.4	74.7	74.7	79.5	75.0	74.5
3	94.7	95.0	93.5	94.2	94.7	94.7	97.7	91.7	97.9
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q40 Leave Computations and Records

	I	II	III	IV	V	VI	VII	VIII	IX
1	22.1	15.0	28.3	22.1	22.1	22.1	20.5	16.7	27.7
2	33.7	30.0	39.1	34.9	33.7	33.7	29.5	31.3	36.2
3	68.4	60.0	73.9	67.4	68.4	68.4	61.4	66.7	70.2
4	95.8	95.0	95.7	95.3	95.8	95.8	97.7	91.7	100.0
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Q41 Record of Overtime

	I	II	III	IV	V	VI	VII	VIII	IX
1	31.6	27.5	37.0	32.6	31.6	31.6	36.4	22.9	40.4
2	60.0	65.0	60.9	62.8	60.0	60.0	65.9	54.2	66.0
3	87.4	85.0	93.5	89.5	87.4	87.4	86.4	81.3	93.6
4	98.9	97.5	100.0	98.8	98.9	98.9	100.0	97.9	100.0
5	100.0	100.0		100.0	100.0	100.0		100.0	

Q42 Productivity Measurement

	I	II	III	IV	V	VI	VII	VIII	IX
1	39.4	35.0	41.3	38.4	39.4	39.4	40.9	43.8	34.8
2	76.6	75.0	76.1	75.6	76.6	76.6	72.7	77.1	76.1
3	92.6	92.5	93.5	93.0	92.6	92.6	90.9	93.8	91.3
4	98.9	97.5	100.0	98.8	98.9	98.9	97.7	100.0	97.8
5	100.0	100.0		100.0	100.0	100.0	100.0		100.0

Q43 History for Future Time Ests.

	I	II	III	IV	V	VI	VII	VIII	IX
1	44.2	45.0	41.3	43.0	44.2	44.2	38.6	45.8	42.6
2	75.8	77.5	73.9	75.6	75.8	75.8	75.0	83.3	68.1
3	90.5	90.0	91.3	90.7	90.5	90.5	90.9	91.7	89.4
4	96.8	97.5	95.7	96.5	96.8	96.8	97.7	97.9	95.7
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Q44 Individual Time on Project

	I	II	III	IV	V	VI	VII	VIII	IX
1	38.3	35.0	40.0	37.6	38.3	38.3	41.9	33.3	43.5
2	72.3	65.0	80.0	72.9	72.3	72.3	76.7	70.8	73.9
3	92.6	95.0	91.1	92.9	92.6	92.6	93.0	91.7	93.5
4	97.9	100.0	95.6	97.6	97.9	97.9	97.7	95.8	100.0
5	100.0		100.0	100.0	100.0	100.0	100.0	100.0	

Q45 Time Worked vs. Estimated

	I	II	III	IV	V	VI	VII	VIII	IX
1	51.6	47.5	54.3	51.2	51.6	51.6	52.3	54.2	48.9
2	77.9	72.5	82.6	77.9	77.9	77.9	79.5	81.3	74.5
3	94.7	95.0	95.7	95.3	94.7	94.7	95.5	95.8	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q46 Recalc Design Sch vs. Time Worked

	I	II	III	IV	V	VI	VII	VIII	IX
1	54.7	52.5	54.3	53.5	54.7	54.7	56.8	45.8	63.8
2	81.1	75.0	87.0	81.4	81.1	81.1	84.1	81.3	80.9
3	90.5	90.0	91.3	90.7	90.5	90.5	90.9	89.6	91.5
4	96.8	95.0	97.8	96.5	96.8	96.8	97.7	95.8	97.9
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Q47 Effect of Leave, TDY, etc.

	I	II	III	IV	V	VI	VII	VIII	IX
1	36.8	30.0	41.3	36.0	36.8	36.8	38.6	33.3	40.4
2	74.7	72.5	78.3	75.6	74.7	74.7	84.1	75.0	74.5
3	92.6	90.0	95.7	93.0	92.6	92.6	93.2	91.7	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q48 Calendar of Future Absences

	I	II	III	IV	V	VI	VII	VIII	IX
1	37.9	32.5	41.3	37.2	37.9	37.9	38.6	39.6	36.2
2	68.4	60.0	73.9	67.4	68.4	68.4	72.7	72.9	63.8
3	91.6	87.5	95.7	91.9	91.6	91.6	90.9	91.7	91.5
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q49 Calendar of all Tied Together

	I	II	III	IV	V	VI	VII	VIII	IX
1	40.4	37.5	40.0	38.8	40.4	40.4	41.9	41.7	39.1
2	75.5	70.0	80.0	75.3	75.5	75.5	79.1	79.2	71.7
3	90.4	87.5	93.3	90.6	90.4	90.4	93.0	89.6	91.3
4	97.9	97.5	97.8	97.6	97.9	97.9	100.0	95.8	100.0
5	100.0	100.0	100.0	100.0	100.0	100.0		100.0	

Q50 Use Real Time Calendar

	I	II	III	IV	V	VI	VII	VIII	IX
1	42.6	40.0	44.4	42.4	42.6	42.6	46.5	43.8	41.3
2	74.5	67.5	80.0	74.1	74.5	74.5	76.7	79.2	69.6
3	93.6	95.0	93.3	94.1	93.6	93.6	95.3	93.8	93.5
4	98.9	100.0	97.8	98.8	98.9	98.9	100.0	97.9	100.0
5	100.0		100.0	100.0	100.0	100.0		100.0	

Q51 All Calcs. Tied to Work Sched.

	I	II	III	IV	V	VI	VII	VIII	IX
1	47.9	47.5	48.9	48.2	47.9	47.9	51.2	47.9	47.8
2	77.7	75.0	80.0	77.6	77.7	77.7	76.7	79.2	76.1
3	92.6	92.5	93.3	92.9	92.6	92.6	90.7	91.7	93.5
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q52 Retrieve Project by Work Req. No.

	I	II	III	IV	V	VI	VII	VIII	IX
1	56.8	46.2	66.0	57.0	56.8	56.8	54.5	58.3	55.3
2	80.0	71.8	85.1	79.1	80.0	80.0	77.3	87.5	72.3
3	96.8	92.3	100.0	96.5	96.8	96.8	93.2	95.8	97.9
4	100.0	100.0		100.0	100.0	100.0	100.0	100.0	100.0
5									

Q53 Retrieve by Facility Number

	I	II	III	IV	V	VI	VII	VIII	IX
1	57.9	43.6	70.2	58.1	57.9	57.9	50.0	56.3	59.6
2	80.0	71.8	83.0	77.9	80.0	80.0	75.0	79.2	80.9
3	91.6	89.7	91.5	90.7	91.6	91.6	90.9	91.7	91.5
4	97.9	100.0	95.7	97.7	97.9	97.9	97.7	95.8	100.0
5	100.0		100.0	100.0	100.0	100.0	100.0	100.0	

Q54 Retrieve by Using Agency Name

	I	II	III	IV	V	VI	VII	VIII	IX
1	36.8	30.8	40.4	36.0	36.8	36.8	36.4	35.4	38.3
2	65.3	53.8	68.1	61.6	65.3	65.3	54.5	64.6	66.0
3	85.3	82.1	85.1	83.7	85.3	85.3	79.5	87.5	83.0
4	93.7	97.4	89.4	93.0	93.7	93.7	90.9	93.8	93.6
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Q55 Retrieve by Designer Name

	I	II	III	IV	V	VI	VII	VIII	IX
1	39.8	30.8	44.4	38.1	39.8	39.8	40.9	43.5	36.2
2	69.9	66.7	66.7	66.7	69.9	69.9	72.7	71.7	68.1
3	90.3	87.2	91.1	89.3	90.3	90.3	86.4	89.1	91.5
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q56 Engineer Assigned to Work Request

	I	II	III	IV	V	VI	VII	VIII	IX
1	54.7	51.3	55.3	53.5	54.7	54.7	47.7	60.4	48.9
2	78.9	82.1	74.5	77.9	78.9	78.9	77.3	81.3	76.6
3	93.7	92.3	93.6	93.0	93.7	93.7	90.9	93.8	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q57 Est. Time to Comp. Work Req.

	I	II	III	IV	V	VI	VII	VIII	IX
1	36.8	35.9	38.3	37.2	36.8	36.8	36.4	35.4	38.3
2	65.3	61.5	68.1	65.1	65.3	65.3	65.9	68.8	61.7
3	89.5	84.6	93.6	89.5	89.5	89.5	84.1	93.8	85.1
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q58 Work Priority for each Work Req.

	I	II	III	IV	V	VI	VII	VIII	IX
1	41.1	30.8	44.7	38.4	41.1	41.1	34.1	35.4	46.8
2	70.5	66.7	72.3	69.8	70.5	70.5	68.2	72.9	68.1
3	87.4	79.5	91.5	86.0	87.4	87.4	79.5	91.7	83.0
4	98.9	100.0	97.9	98.8	98.9	98.9	97.7	100.0	97.9
5	100.0		100.0	100.0	100.0	100.0	100.0		100.0

Q59 Wk. Req. Priority for Proj. Engr.

	I	II	III	IV	V	VI	VII	VIII	IX
1	42.1	38.5	44.7	41.9	42.1	42.1	43.2	37.5	46.8
2	71.6	64.1	76.6	70.9	71.6	71.6	70.5	72.9	70.2
3	91.6	84.6	95.7	90.7	91.6	91.6	88.6	93.8	89.4
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q60 Work Req. Est. Completion Date

	I	II	III	IV	V	VI	VII	VIII	IX
1	52.1	38.5	60.9	50.6	52.1	52.1	46.5	55.3	48.9
2	76.6	71.8	78.3	75.3	76.6	76.6	74.4	80.9	72.3
3	92.6	87.2	95.7	91.8	92.6	92.6	88.4	93.6	91.5
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q61 General Comments on Work Req.

	I	II	III	IV	V	VI	VII	VIII	IX
1	34.8	28.9	42.2	36.1	34.8	34.8	35.7	36.2	33.3
2	65.2	60.5	68.9	65.1	65.2	65.2	61.9	59.6	71.1
3	87.0	81.6	88.9	85.5	87.0	87.0	81.0	87.2	86.7
4	94.6	92.1	95.6	94.0	94.6	94.6	92.9	93.6	95.6
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Q62 A&E Board Dates and Members

	I	II	III	IV	V	VI	VII	VIII	IX
1	43.2	40.0	44.7	42.5	43.2	43.2	46.7	41.7	44.7
2	65.3	62.5	63.8	63.2	65.3	65.3	66.7	68.8	61.7
3	87.4	85.0	87.2	86.2	87.4	87.4	86.7	89.6	85.1
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q63 List Projects by A&E

	I	II	III	IV	V	VI	VII	VIII	IX
1	69.5	72.5	68.1	70.1	69.5	69.5	73.3	70.8	68.1
2	88.4	90.0	85.1	87.4	88.4	88.4	93.3	91.7	85.1
3	98.9	100.0	97.9	98.9	98.9	98.9	100.0	97.9	100.0
4	100.0		100.0	100.0	100.0	100.0		100.0	
5									

Q64 Reminders of A&E Due Dates

	I	II	III	IV	V	VI	VII	VIII	IX
1	73.7	70.0	74.5	72.4	73.7	73.7	80.0	77.1	70.2
2	91.6	97.5	85.1	90.8	91.6	91.6	97.8	91.7	91.5
3	98.9	100.0	97.9	98.9	98.9	98.9	100.0	97.9	100.0
4	100.0		100.0	100.0	100.0	100.0		100.0	
5									

Q65 A&E Percent Complete vs. Sched.

	I	II	III	IV	V	VI	VII	VIII	IX
1	63.2	60.0	63.8	62.1	63.2	63.2	64.4	62.5	63.8
2	85.3	90.0	78.7	83.9	85.3	85.3	86.7	85.4	85.1
3	94.7	95.0	93.6	94.3	94.7	94.7	93.3	93.8	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

	I	II	III	IV	V	VI	VII	VIII	IX

Q66 General Notes on A&E's

	I	II	III	IV	V	VI	VII	VIII	IX
1	39.4	35.0	43.5	39.5	39.4	39.4	40.0	36.7	42.2
2	73.4	72.5	76.1	74.4	73.4	73.4	75.6	71.4	75.6
3	89.4	92.5	87.0	89.5	89.4	89.4	93.3	85.7	93.3
4	96.8	97.5	95.7	96.5	96.8	96.8	100.0	95.9	97.8
5	100.0	100.0	100.0	100.0	100.0	100.0		100.0	100.0

Q67 Records for MCP

	I	II	III	IV	V	VI	VII	VIII	IX
1	68.8	62.5	70.2	66.7	68.8	68.8	68.9	69.4	68.1
2	91.7	90.0	91.5	90.8	91.7	91.7	93.3	91.8	91.5
3	95.8	95.0	95.7	95.4	95.8	95.8	97.8	95.9	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q68 Drafting Section Work Priorities

	I	II	III	IV	V	VI	VII	VIII	IX
1	65.6	62.5	66.0	64.4	65.6	65.6	71.1	71.4	59.6
2	85.4	87.5	83.0	85.1	85.4	85.4	91.1	87.8	83.0
3	93.8	92.5	95.7	94.3	93.8	93.8	95.6	91.8	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q69 Record of Drawing Updates

	I	II	III	IV	V	VI	VII	VIII	IX
1	53.1	47.5	55.3	51.7	53.1	53.1	51.1	63.3	42.6
2	78.1	75.0	80.9	78.2	78.1	78.1	84.4	79.6	76.6
3	91.7	90.0	93.6	92.0	91.7	91.7	91.1	89.8	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q70 Supply Management Records

	I	II	III	IV	V	VI	VII	VIII	IX
1	37.5	27.5	42.6	35.6	37.5	37.5	33.3	42.9	31.9
2	65.6	67.5	66.0	66.7	65.6	65.6	66.7	67.3	63.8
3	90.6	87.5	93.6	90.8	90.6	90.6	91.1	85.7	95.7
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

Q71 Site Survey Management

	I	II	III	IV	V	VI	VII	VIII	IX
1	46.9	45.0	46.8	46.0	46.9	46.9	44.4	49.0	44.7
2	75.0	77.5	70.2	73.6	75.0	75.0	77.8	71.4	78.7
3	90.6	92.5	89.4	90.8	90.6	90.6	91.1	87.8	93.6
4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5									

	I	II	III	IV	V	VI	VII	VIII	IX

Q72 Digging Permit Records

	I	II	III	IV	V	VI	VII	VIII	IX
1	26.6	17.5	28.9	23.5	26.6	26.6	25.0	27.1	26.1
2	53.2	45.0	55.6	50.6	53.2	53.2	50.0	56.3	50.0
3	77.7	70.0	80.0	75.3	77.7	77.7	75.0	77.1	78.3
4	98.9	100.0	97.8	98.8	98.9	98.9	100.0	100.0	97.8
5	100.0		100.0	100.0	100.0	100.0			100.0

Q73 Modem for Use From Home to Work

	I	II	III	IV	V	VI	VII	VIII	IX
1	21.1	17.9	23.4	20.9	21.1	21.1	15.9	16.7	25.5
2	36.8	41.0	34.0	37.2	36.8	36.8	31.8	29.2	44.7
3	62.1	71.8	53.2	61.6	62.1	62.1	61.4	58.3	66.0
4	93.7	97.4	89.4	93.0	93.7	93.7	86.4	93.8	93.6
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Q74 Modem for Contract Comp. Services

	I	II	III	IV	V	VI	VII	VIII	IX
1	45.7	46.2	43.5	44.7	45.7	45.7	38.6	47.9	43.5
2	71.3	79.5	65.2	71.8	71.3	71.3	72.7	72.9	69.6
3	85.1	92.3	80.4	85.9	85.1	85.1	86.4	83.3	87.0
4	90.4	94.9	87.0	90.6	90.4	90.4	88.6	87.5	93.5
5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix D: Desired Capabilities Ranked According to Percentage of "Very Useful" Responses

The following table contains the 74 computer capabilities (Q1 - Q74) discussed earlier. These capabilities have been ranked based upon the percentage of "Very Useful" responses received from Group I (All respondents collectively) for each capability . In case of a tie between two or more capabilities, the percentage of "Moderately Useful" and "Slightly Useful" responses was used to break the tie. In case the tie could not be broken, the tied capabilities have each been given two ranks in order to keep the numbering system in the correct order. Following each question number in the table, a very short description has been given of the corresponding capability. For a more detailed description of the capability, the reader should refer back to the copy of the questionnaire contained in Appendix B.

Rank	Quest.	Percent	Description
1/2	Q3	95.7	Project Number
1/2	Q4	95.7	Project Name
3	Q10	88.3	Percent Design Complete
4	Q11	86.2	Estimated Design Completion Date
5	Q5	85.1	Project Overall Priority
6	Q14	84.0	Name of Project Arch. or Engr.
7	Q28	81.1	Priorities by Various Categories
8	Q9	79.8	Current Working Cost Estimates
9	Q6	78.7	EEIC Funds Type
10	Q17	78.7	A&E Milestone Dates if Applicable
11	Q33	77.9	Print Any Data on Viewgraph Slide
12	Q64	73.7	Reminders of A&E Due Dates
13	Q8	72.3	1391 Cost Estimates
14	Q63	69.5	List Projects by A&E
15	Q29	69.5	Selective Listings of Data

Rank	Quest.	Percent	Description
16	Q67	68.8	Records for MCP
17	Q22	68.4	Effects of Introducing New Projs.
18	Q16	67.0	Name of A&E if Applicable
19	Q34	66.3	Individual Work Assignments
20	Q68	65.6	Drafting Section Work Priorities
21	Q65	63.2	A&E Percent Complete vs. Sched.
22	Q32	63.2	Calc. of % Complete by a Date
23	Q20	61.7	Calc. No. of Projs. Complete
24	Q24	60.0	Effects of Shuffling Priorities
25	Q18	59.6	Using Agency Point of Contact
26	Q25	58.9	Effects of Losing Key People
27	Q31	57.9	Data on Select Group of Projects
28	Q53	57.9	Retrieve by Facility Number
29	Q52	56.8	Retrieve Project by Work Req. No.
30	Q46	54.7	Recalc Design Sch vs. Time Worked
31	Q56	54.7	Engineer Assigned to Work Request
32	Q27	53.7	Hrs. Breakdown by Discipline
33	Q69	53.1	Record of Drawing Updates
34	Q38	52.1	Schedule of Indiv. Leave TDY etc.
35	Q23	52.1	Effects of Project Delays
36	Q60	52.1	Work Req. Est. Completion Date
37	Q7	52.1	Date of 1391 Completion
38	Q45	51.6	Time Worked vs. Estimated
39	Q19	51.1	General Notes about the Project
40	Q21	50.5	Calc. of Overtime on Comp. Date
41	Q12	50.0	Est. Hrs. to Comp. by Discipline
42	Q51	47.9	All Calcs. Tied to Work Schd.
43	Q26	47.4	Effects of Leave, TDY, etc.
44	Q71	46.9	Site Survey Management
45	Q1	46.8	13 Month Calendar
46	Q15	46.2	Names of all Archs. and Engrs.
47	Q74	45.7	Modem for Contract Comp. Svcs.
48	Q39	45.3	Individual Calendar of Events
49	Q13	44.7	Est. of Drafting Hrs. to Comp.
50	Q43	44.2	History for Future Time Ests.
51	Q62	43.2	A&E Board Dates and Members
52	Q50	42.6	Use Real Time Calendar
53	Q2	42.6	Electronic Mail
54	Q59	42.1	Wk. Req. Priority for Proj. Engr.
55	Q35	41.1	Record of Past Training and Ed.
56	Q58	41.1	Work Priority for each Work Req.
57	Q36	41.1	Listing of Additional Duties
58	Q49	40.4	Calendar of all Tied Together
59	Q30	40.0	Selective Listings by Agency
60	Q55	39.8	Retrieve by Designer Name
61	Q42	39.4	Productivity Measurement
62	Q66	39.4	General Notes on A&E's
63	Q44	38.3	Individual Time on Project
64	Q48	37.9	Calendar of Future Absences
65	Q70	37.5	Supply Management Records

Rank	Quest.	Percent	Description
66	Q47	36.8	Effect of Leave, TDY, etc.
67	Q57	36.8	Est. Time to Comp. Work Req.
68	Q54	36.8	Retrieve by Using Agency Name
69	Q61	34.8	General Comments on Work Req.
70	Q41	31.6	Record of Overtime
71	Q37	31.6	List of Committee Memberships
72	Q72	26.6	Digging Permit Records
73	Q40	22.1	Leave Computations and Records
74	Q73	21.1	Modem for Use From Home to Work

Additional Suggested Capabilities

The capabilities listed above are limited to those that specifically appeared on the thesis questionnaire. The capabilities that are discussed below have been taken from the remarks section of the questionnaire and were handwritten there by the respondents. Because they were not prioritized by everyone, they are included here for the readers information. They are not included in Appendix E.

In the area of Design Section Management, capabilities 3 through 33, include:

1) The capability to cross reference between the Work Order Number, the Project Number, and the Contract Number.

2) Extend capability 20, Evaluation of number of projects by a certain date, to include the capability to print this information graphically.

3) Extend capability 20, Listing by various categories, to include type of funding, design due date, building number, category code, and type of project.

In the area of Total Work Schedule Management,

capabilities 34 through 61, include:

4) The capability to list jobs that have been added to the schedule that are not normally scheduled.

5) The capability to track suggestion evaluation.

6) The capability to track Roof, Pavement, and Corrosion Control Programs.

7) Extend capability 52, Retrieve by Work Request Number, to include the ability to retrieve by Work Order Number and Job Order Number.

In the area of Architectural Engineering Firm Management, capabilities 62 through 66, include:

8) The capability to contain the point of control between the Design Section and the A&E firm.

In the area of Drafting Section Management, capabilities 68 through 72, include:

9) The capability to track machine maintenance.

10) The capability to perform manhour calculations for the Drafting Section personnel.

11) The capability to interact with any Computer Aided Drafting and Design system that is in the Design Section.

Appendix E: Desired Capabilities Ranked According to Total Percentage of "Very Useful" Plus "Moderately Useful" Responses

The following table contains the 74 computer capabilities (Q1 - Q74) discussed earlier. These capabilities have been ranked based upon the percentage of "Very Useful" and "Moderately Useful" reponses received from Group I (All respondents collectively) for each capability. In case of a tie between two or more capabilities, the percentage of "Very Useful", "Moderately Useful," and "Slightly Useful" responses was used to break the tie. In case the tie could not be broken, the tied capabilities have each been given two ranks in order to keep the numbering system in the correct order. Following each question number in the table, a very short description has been given of the corresponding capability. For a more detailed description of the capability, the reader should refer back to the copy of the questionnaire contained in Appendix B.

Rank	Quest.	Percent	Description
1/2	Q3	98.9	Project Number
1/2	Q4	98.9	Project Name
3	Q10	98.9	Percent Design Complete
4	Q5	96.8	Project Overall Priority
5	Q28	95.8	Priorities by Various Categories
6	Q8	95.7	1391 Cost Estimates
7	Q11	95.7	Estimated Design Completion Date
8	Q33	94.7	Print any Data on Viewgraph Slide
9	Q14	93.6	Name of Project Arch. or Engr.
10	Q6	92.6	EEIC Funds Type
11	Q9	92.6	Current Working Cost Estimates
12	Q67	91.7	Records for MCP

Rank	Quest.	Percent	Description
13	Q64	91.6	Reminders of A&E Due Dates
14	Q17	91.5	A&E Milestone Dates if Applicable
15	Q63	88.4	List Projects by A&E
16	Q29	88.4	Selective Listings of Data
17	Q34	88.4	Individual Work Assignments
18	Q68	85.4	Drafting Section Work Priorities
19	Q65	85.3	A&E Percent Complete vs. Sched.
20	Q22	84.2	Effects of Introducing New Projs.
21	Q16	84.0	Name of A&E if Applicable
22	Q25	83.2	Effects of Losing Key People
23	Q19	83.0	General Notes about the Project
24	Q18	83.0	Using Agency Point of Contact
25	Q31	82.1	Data on Select Group of Projects
26	Q26	82.1	Effects of Leave, TDY, etc.
27	Q20	81.9	Calc. No. of Projs. Complete
28	Q32	81.1	Calc. of % Complete by a Date
29	Q46	81.1	Recalc Design Sch vs. Time Worked
30	Q12	80.9	Est. Hrs. to Comp. by Discipline
31	Q52	80.0	Retrieve Project by Work Req. No.
32	Q24	80.0	Effects of Shuffling Priorities
33	Q53	80.0	Retrieve by Facility Number
34	Q38	79.8	Schedule of Indiv. Leave TDY etc.
35	Q23	79.8	Effects of Project Delays
36	Q15	79.3	Names of all Archs. and Engrs.
37	Q56	78.9	Engineer Assigned to Work Request
38	Q69	78.1	Record of Drawing Updates
39	Q45	77.9	Time Worked vs. Estimated
40	Q51	77.7	All Calcs. Tied to Work Sched.
41	Q60	76.6	Work Req. Est. Completion Date
42	Q42	76.6	Productivity Measurement
43	Q43	75.8	History of Future Time Ests.
44	Q7	75.5	Date of 1391 Completion
45	Q1	75.5	13 Month Calendar
46	Q49	75.5	Calendar of all Tied Together
47	Q13	75.5	Est. of Drafting Hrs. to Comp.
48	Q71	75.0	Site Survey Management
49	Q39	74.7	Individual Calendar of Events
50	Q47	74.7	Effect of Leave, TDY, etc.
51	Q27	74.7	Hrs. Breakdown by Discipline
52	Q50	74.5	Use Real Time Calendar
53	Q21	73.7	Calc. of Overtime on Comp. Date
54	Q2	73.4	Electronic Mail
55	Q66	73.4	General Notes on A&E's
56	Q44	72.3	Individual Time on Project
57	Q59	71.6	Wk. Req. Priority for Proj. Engr.
58	Q74	71.3	Modem for Contract Comp. Svcs.
59	Q35	70.5	Record of Past Training and Ed.
60	Q58	70.5	Work Priority for each Work Req.
61	Q55	69.9	Retrieve by Designer Name
62	Q30	69.5	Selective Listings by Agency

Rank	Quest.	Percent	Description
63	Q36	68.4	Listing of Additional Duties
64	Q48	68.4	Calendar of Future Absenses
65	Q70	65.6	Supply Management Records
66	Q57	65.3	Est. Time to Comp. Work Req.
67	Q62	65.3	A&E Board Dates and Members
68	Q54	65.3	Retrieve by Using Agency Name
69	Q61	65.2	General Comments on Work Req.
70	Q41	60.0	Record of Overtime
71	Q37	57.9	List of Committee Memberships
72	Q72	53.2	Digging Permit Records
73	Q73	36.8	Modem for Use From Home to Work
74	Q40	33.7	Leave Computations and Records

Appendix F: Demographic Data

A copy of the demographic questions from the questionnaire follows. For the multiple choice questions, the percentage of respondents answering a particular response has been inserted in front of the response. For the fill in the blank questions, the responses have been divided into groups; then the percentage of people in each group has been noted.

VIII. DEMOGRAPHIC INFORMATION

For the following questions, please circle the letter that corresponds to your desired answer.

75. What is your age in years?

0% a. 21-25 7.3% c. 31-35 11.5% e. 41-45
2.1% b. 26-30 22.9% d. 36-40 56.3% f. 46 & above

76. What is your engineering discipline?

8.3% a. Architect
51.0% b. Civil
18.8% c. Mechanical
14.6% d. Electrical
7.3% e. Other, please specify________________________.

77. What is your highest education level?

22.9% a. B.S. Degree 11.5% c. Master's Degree
54.2% b. B.S.+ some grad. work 11.5% d. Master's +

78. What is your present job title?

42.1% a. Chief of Engineering Design
49.5% b. Chief of Engineering and Environmental
8.4% c. Other, please specify______________________.

79. How long have you worked in your present job (to the nearest year)?

33.3% a. 0-1
26.0% b. 2-3
10.4% c. 4-5
30.2% d. more than 5 years

80. Answer this question only if you are not presently the Chief of Engineering Design. In the past, how long did you work as a Chief of Design?

33.3% a. no time worked
5.9% b. less than 1 yr
25.5% c. 1 but less than 3 yrs
11.8% d. 3 but less than 5 yrs
23.5% e. 5 or more yrs

81. How long have you worked as a design engineer or architect?

5.3% a. no time worked
2.1% b. less than 1 yr
7.4% c. 1 but less than 3 yrs
12.6% d. 3 but less than 5 yrs
72.6% e. 5 or more yrs

82. How long have you worked as a design engineer or architect for the Air Force?

10.5% a. no time worked
3.2% b. less than 1 yr
14.7% c. 1 but less than 3 yrs
11.6% d. 3 but less than 5 yrs
60.0% e. 5 or more yrs

83. How long have you worked in Air Force Civil Engineering?

0% a. no time worked
1.1% b. less than 1 yr
3.2% c. 1 but less than 3 yrs
5.3% d. 3 but less than 5 yrs
90.5% e. 5 or more yrs

84. How long have you worked for your current Major Air Command?

1.1% a. no time worked
5.2% b. less than 1 yr
13.5% c. 1 but less than 3 yrs
4.2% d. 3 but less than 5 yrs
75.0% e. 5 or more yrs

85. What Major Air Command do you work for?

MAC	23.2%
SAC	28.4%
TAC	17.9%
ATC	15.8%
AFRES	1.1%
AFSC	1.1%
SPACECO	1.1%
AFLC	10.5%
USAFA	1.1%

86. Approximately how many people (total military and civilian) work in your squadron?

0-100	2%
101-200	6%
201-300	11%
301-400	34%
401-500	17%
501-600	13%
601-700	3%
701-800	2%
801-900	3%
901-1000	2%
1001-1100	0%
1101-1200	1%

87. Approximately how many people (total military and civilian) work on your base?

0-3000	13%
3001-6000	39%
6001-9000	15%
9001-12000	9%
12001-15000	4%
15001-18000	6%
18001-21000	3%
21001-24000	2%
24001-27000	1%
27001-30000	0%
30001-33000	1%

How many people (including technicians) do you have working in each of the following disciplines in your design section? (please fill in)

88. Architecture

0-2	50.6%
3-4	30.2%
5-6	9.7%
7-8	3.3%
9-10	2.2%
11-12	2.2%
13-14	1.1%
15-16	1.1%

89. Civil

0-2	13.9%
3-4	44.7%
5-6	27.7%
7-8	6.4%
9-10	5.3%
11-12	1.1%
13-14	1.1%

90. Mechanical

0-2	44.7%
3-4	36.2%
5-6	9.6%
7-8	4.2%
9-10	1.1%
11-12	4.3%

91. Electrical

0-2	59.5%
3-4	26.5%
5-6	6.4%
7-8	4.3%
9-10	2.2%
11-12	1.1%

92. Drafting

0-2	4.5%
3-4	5.6%
5-6	28.1%
7-8	31.5%
9-10	15.7%
11-12	12.4%
13-14	1.1%
15-16	1.1%

93. Other

0-2	84.9%
3-4	7.6%
5-6	5.5%
7-8	1.1%
9-10	0%
11-12	0%
13-14	1.1%

94. In the design section, do you have a lead engineer or architect who is both formally in charge of each discipline and who writes evaluation reports on the others in his discipline?

31.6% a. yes 68.4% b. no

95. Have you ever had any familiarization (or orientation) on the Work Information Management System (WIMS)?

35.1% a. yes 64.9% b. no

96. Do you routinely use a desk top computer system either at work or at home?

23.2% a. yes 76.8% b. no

97. If the answer to the above question was yes, where do you use it? If the answer was no, skip this question.

26.1% a. work 26.1% b. home 47.8% c. both

98. Have you ever worked with a Management Information System or Decision Support System? If you do not understand these terms, please answer no to this question.

25.0% a. yes 75.0% b. no

Appendix G: Questionnaire Remarks

The remarks on the following pages were hand written on the questionnaires by the respondents and are included here for the reader so that he can analyze them and draw his own conclusions. Even though some respondents gave their name and organization so that the authors could communicate with them, the authors felt that it would be best to not include those names and addresses here in the interest of encouraging uninhibited responses to similar questionnaires in the future. Remarks were encouraged on the questionnaire and it was desired that there be no attribution of remarks to anyone so that people would give their honest opinions. In most cases, the author's do not know from whom the remarks came. The reader will note that some remarks take a shorthand or abbreviated form. They are copied here as they appeared on the questionnaires.

The paragraph included in the questionnaire which solicited these remarks follows immediately:

REMARKS:

Please write any comments and ideas that you feel would contribute to the development of a computer management system for use by the Chief of Engineering Design.

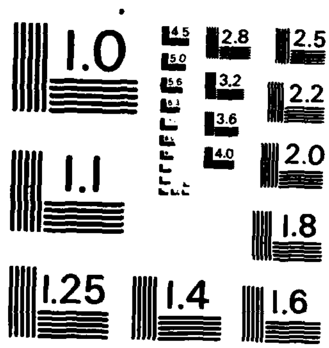
AD-A160 927 IDENTIFICATION OF DESIRED COMPUTER CAPABILITIES FOR MANAGEMENT OF AN AIR..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 2/2

UNCLASSIFIED J P MILLER ET AL. SEP 85 F/G 5/1 NL

END

FILMED

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Remark Set 1:

The optimum design CADD system needs to have direct, desk-top review capability for both DEEE, DEE, and DEEC. Overlays would allow direct annotation on working drawings, with memos/review comments all visible to designer who would incorporate or reply to author. Zoom on details, review of specs, design analysis, etc., would be desk-top, on going and allow critical feedback to designer for quality enhancement.

Remark Set 2:

Need to provide a system which ties into both Procurement and Budget/Cost Accounting.

1. Procurement works only with the contract number
2. Budget/Cost Accounting works only with the BEAMS work order number
3. Design Section works only with project number
4. No cross reference exists unless it is maintained manually
5. Need desk-top terminals on each desk mentioned above with a cross reference file
6. Need to solicit a list of needed data from each office and write a program to accommodate

Remark Set 3:

I fully support the effort to get micro computers into our office. It will certainly alleviate a lot of paper and

file searches for information that customers or commanders are always asking for by being faster and more accurate.

Other areas of Application:

Real Estate
- track building custodians/Fac Resp Officer (FRO)
- bldg disposal listing
- real estate records
- status of various

Contract Management
- status of construction
- status of service contracts
- work assignment to inspectors/QAE's

Programming
- DD 1391 preparation schedule
- Cat Code requirement
- facility deficiencies
- work assignment

Remark Set 4.

[With respect to question 2, Electronic Mail]

More useful if staff being supervised had terminals.

Remark Set 5:

[With respect to questions 52 through 61, Work Request Management]

Work order number is lost when a project number is assigned by the Design Section. Customer Service needs to cross reference.

Remark Set 6:

Has been badly needed for a long time!

Remark Set 7:

I've recognized the need for such a system for a long time. A system with all these capabilities would be nice, but a system with just half would be a godsend. If you're thinking about developing such a system, PLEASE HURRY!

Remark Set 8:

My only comment is I hope you have better luck than I do. I have been trying for 5 years to get a micro computer system for our Engineering Section with no results. I have had five different Project Officers and none have met with success. It seems that someone or several offices have been undermining our efforts. Perhaps your research can help facilitate our acquisition.

Remark Set 9:

The computer would be a big help---

Just don't OVER KILL!

Remark Set 10:

Most of the information that was questioned in this questionnaire is already available with the CECORS file and retrievals. Too much of the items asked about, such as the calculation of effects of switching priorities, overtime, etc., are a lot of fancy what if eyewash that does nothing to help get a project designed. If an installation commander wants a project accomplished, (we will work whatever overtime or priority it takes), it will be done no

matter how many computerized reports we provide that say it will be detrimental to the design program. Also, some individual(s), will be spending more time inputting data into the system instead of designing. The present system, despite many problems, works fairly well with a limited number of retrievals. The WIMS, by providing so many terminals is destined to reduce design effort because too much time will be spent inputting or reviewing data.

Remark Set 11:

If we're not careful, we could spend more time/effort on establishing and maintaining the data file than we spend on design.

Remark Set 12:

[With respect to questions 52 through 61, Work Request Management]

Recognize that work requests are managed by exception with a goal of work request turn around in 30 days (optimum)

[With respect to questions 62 through 66, Architectural Engineering Firm Management]

This would be a duplication of other documentation (i.e. AE progress payment information is managed by a project/AE manager.

[With respect to question 67, MCP Management]

Corps of Engineers provides base level mgmt with

monthly update on MCP project status.

[With respect to questions 68 through 72]

Drafting section requirements need to be managed day to day. Data file on a computer would be too volatile (i.e. constant updating).

[With respect to question 72, Digging Permits]

duplication of existing records

[Remarks]

As you well know the management variables that impact the manner [in which] we do business are many. Some of which are generated by engineering counterparts in MAJCOM, some from Comptroller channels and to a large extent, users or receivers of engineering effort. I'm skeptical in the implementation of a management information system in that the critical path will be the time and personnel to update the data file such that the information can be retrieved. Manning for this, normally, administrative functions is not considered nor can be supported by existing manning standards. For supervisors to accomplish this function is the reason why our Z-100 desk tops are not used as frequently as it could.

Remark Set 13:

I think the computer aids described herein would be an outstanding asset to the Design Section. Similar system should also be considered for Construction Management. The only hang up is that DEE should be authorized a manning

position (GS-4 or 5) Clerk to input the data which is constantly changing. We can't afford to have a GS-12 engineer spending hours of time on data entry. The typists authorized for our branch are already over taxed and could not give up this time either.

Remark Set 14:

[With respect to questions 3 through 17]

Currently our Wang system provides most of this. We do have a severe hardware limitation in available terminals, printers, and programming support.

Remark Set 15:

[With respect to questions 21 through 27, Design Schedule and Derivatives]

Sounds like C. Y. A.

Not productive scheduling

[With respect to question 34, Total Work Schedule and Derivatives]

Listing of all added jobs not normally scheduled.

[With respect to question 40, pay and leave computation]

Who has the free time to enter all of this? Lots of this is CPO's responsibility.

[With respect to question 74, Contract Computer Services Desired]

Modem access cost estimation

McGraw-Hill Information Systems Co.
P.O. Box 28
Princeton, New Jersey, 08540
800-257-5295

Related spec processing company

Master Specification
AIA Service Corporation
1735 New York AVE. NW.
Washington D.C. 20006

Remark Set 16:

Programs should be "user friendly" and should be designed so that the user runs the programs rather than the program running the user.

Availability of a Management System containing the capabilities indicated in the survey should greatly increase the capabilities of Civil Engineering and the Engineering and Environmental Planning Branch.

Get this system out in the field NOW. Don't just promise these capabilities like the WIMS that has been advertised for 3-4 years but we still don't have. If it is a viable system it should [be] purchased and delivered to all potential users immediately.

Remarks Set 17:

[With respect to question 38, Total Work Schedule and Derivatives, individual listing of absence]

Need to include Prime Beef Duties

[With respect to question 52, Work Request Management]

Work request breakout to - Work Request
- W.O. Number
- Job Order

[With respect to questions 34 through 51, Total Work Schedule and Derivatives]

Add suggestion eval. too?

[With respect to questions 62 through 66, Architectural Engineering firm management]

Need point of contact bet.[between] A & E and Base Engineer (usually from Design Section).

[With respect to questions 68, Drafting Section work priorities]

Set aside priorities for:

Contract Projects (Construction)

Service Contract Projects

Others

[With respect to question 68 through 72, Drafting Section Management]

Add when is machine maintenance due?

manhours calculation for draftsmen

manhours calculation for specs typed/secretary

Remark Set 18:

Keep the system simple.

Remark Set 19:

The majority of information indicated for computer input & retrieval would be more beneficial to private

industry, as they work on costs & <u>profit</u> bases, where the military does not. There are too many agencies involved in projects to realistically establish time tables, priorities etc., even though it is attempted. Too many changes and interruptions occur during project design in priorities, scope of work and scheduled work.

<u>Remark Set 20:</u>

Information is necessary for successful management. Any improvement in information exchange is desirable.

<u>Remark Set 21:</u>

Typing and drafting capability can have a big influence on engineering capability.

Training seminars in use of computer would be advantageous for engineers, secretaries, draftsmen and inspectors.

<u>Remark Set 22:</u>

[With respect to questions 52 through 61, Work Request Management]

Very important for control!

[REMARKS]

Let's get on with it!

<u>Remark Set 23:</u>

Need someone authorized to do the programming of the computer so it does not take the time of the Design Chief

to operate it.

<u>Remark Set 24:</u>

Suggest the Air Force check out the modern AE firms as well as the Army, Navy, and Marines who have probably answered these same questions several years ago.

<u>Remark Set 25:</u>

[With respect to question 30, Design Schedule, selective listing of projects by using agency key personnel]

(at begin of FY --- prioritizing w/ FB [Facilities Board])

[With respect to question 66, general notes on A & E performance]

(so long as the info. is classified!)

<u>Remark Set 26:</u>

[With respect to questions 50 to 61, Work Request Management]

for DEEV/DEM

[With respect to question 73, Telephone Modem, work from home]

Is the Air Force going to buy me one and pay my OT?

<u>Remark Set 27:</u>

Need some good software packages with it. i.e., heatload, structural, etc.

<u>Remark Set 29:</u>

[With respect to question 67, MCP management]

We get weekly update from corps on projects under contract.

Remark Set 30:

Make reports flexible to allow easy revision for individual needs.

Keep inputs realistic by considering source of information and time required to obtain information.

Make system for first level management not upper level micro management.

Make system work for user not user work for system.

This questionnaire is an excellent start.

Remark Set 31:

Excellent shopping list of capabilities.

Where do we get the software for our Z-100?

Remark Set 32:

[With respect to question 40, pay and leave computations]

Already done by personnel for us.

[REMARKS]

This all sounds wonderful. Get it out here ASAP.

Remark Set 33:

[With respect to question 2, electronic mail, respondent answered "Very Useful"]

Especially if automatic to proceed

to next day --- tied in so secretary can post.

Remark Set 34:

I use my Z-100 for info similar to questions here, except for manhours (etc.). I designed my own system & found it very useful. I would suggest that whatever is done, it be adaptive to individual needs. Programs should be provided but not made mandatory. People who will use the system will develop their own & use it on the supplied system.

You should look into the manpower standard for 4421. We could use a 702 in that section to update & manage the system. Maybe at that point I would agree to daily manhour input.

Roof, pavements & Corrosion programs should be integrated. I get as many questions on that as design schedule.

I hope your study comes of some use.

Remark Set 35:

Let's not get a system that requires 10% more people to keep updated or become a dependent to the machine like Base Supply.

Remark Set 36:

[With respect to question 286, Design Schedule and Derivatives, automatic listing of projects, FY, and any of the following]

Would like to add several more automatic listing capabilities --- by:

- type of funding (MFP-7, MFH, DMIF, etc.)
- design due date
- bldg no./Cat Code
- energy projects
- fire safety codes
- quality of life
- etc.

Remark Set 37:

[With respect to question 98, Demographic, have you worked with an MIS or DSS]

Using DE's terminal!! We have no equipment, other than word processing, in the engineering branch as yet . . . and the w-p is by the grace of DEM allowing file space to be used.

[REMARKS]

The AF manuals task the development of a design schedule manually (bar graph, etc.) --- and the IG asks for an "integrated design priority/schedule" --- for 300+ projects? The type of software needed is a Critical Path Method, recognizing individual capabilities --- this is no simple system!! Current programs (CECORS, CREATE, etc.) available are wholly inadequate for design scheduling. . . the design chief is still saddled with "buggy whip technology" --- in a space age environment.

At the very least --- when we have software capability --- design supervisors should have a terminal at their desks.

Remark Set 38:

[With respect to question 2, electronic mail, respondent answered "Not Useful"]

We're too small, but would be great if we could send to MAJCOM!

Remark Set 39:

[With respect to question 13, Design Schedule, estimated drafting hours required to complete the project, respondent answered "Not Useful"]

Would probably become a 1 ["Very Useful"] or 2 ["Moderately Useful"] when we get CADD.

[With respect to question 20, Design Schedule, number of projects that can be completed by a certain date]

A completion date for each project is not desirable because it is impractical to obtain except from conversation with designer. Projects are not always worked in priority order.

[REMARKS]

AFLC has a computer program to do design scheduling. It is set up so that each project's completion date is calculated. This is a worthless and misleading feature because projects are not worked in priority order. The Chief of Eng. needs to know how much total work can be completed in any given period, i.e., 3 mo., 6 mo., 1 year, 2 years, not when an individual project can be completed.

Individual projects are handled by discussing with the engineer & using judgement.

The chief needs to be able to assess the effect on going A-E or in-house with the computer program. He needs to have the computer consider such factors as leave, training, design time, other-engineering time, design efficiency (i.e. actual vs estimated), overtime, etc.

The A-E designed projects also generally need to be kept in a separate section from the rest of the projects after they go to Base Contracting because thereafter their completion is determined by contract, not by priority.

Remark Set 40:

For the purposes of the Chief of Engineering Design the most important capabilities of a Work Management System is to be able to almost constantly monitor and update the design schedule and each engineer's work load. This office is successfully utilizing an Apple III micro computer with PFS and VISI CALC software for design schedule records and manipulation and man hour evaluation and manipulation. It is most likely possible to secure "off-the-shelf" software that will more than adequately serve the requirements of the Design Chief and Chief of Engineering. It has been the experience of this office that interfacing with other terminals or systems in not of major significance.

The micro computer used by this office has a powerful word processing capability which is considered a major

requirement for not only Design Chief but the entire Design Section. This type arrangement is considered more flexible and useable than being tied to a "main frame" type word processor system. However, access through telephone modem to a central cost estimating program such as Boeing or McAuto or CDC which utilize DODGE or Means information would be extremely useful. An additional service which is available through information Handling Service Inc. is the TECH-NET information researching system. This allows an engineer to find manufacturers and/or suppliers utilizing an "electronic catalog" not unlike Sweets thus speeding up ones ability to find and specify or obtain information relative to a project.

Remark Set 41:

[With respect to question 2, electronic mail, respondent answered "Very Useful"]

Provided I can make a hardcopy of the msg I send too.

Remark Set 42:

[With respect to question 42 and 43, Manhour Accounting, record of overtime and productivity measurement, the respondent answered "Very Useful" to both and annotated each with a "+++"]

[REMARKS]

I believe that the sooner we get on w/ computerized system and have good programs the better. We will need

people to input and maintain. Managers do not have time to waste w/ computerese and typing in. We would save lots of $ by better and faster accountability and production or productivity measurement. Needs to be used sensibly and by human, right brained managers. Need to keep MBA types at bay. They salivate at thoughts of numbers, control, stop watches. But, they are the bane of productivity if not kept in place. Looks like someone is beginning to think. Hurry up. We need help fast. Waiting for the mythical WIMS monster is killing us.

Remark Set 43:

I hope that software to accomplish many of the above capabilities will pursued soon. As Z-100's become more available many of us would like to use them to accomplish these things. It seems to be a waste of manpower for many of us to spend large amounts of time solving the same problem.

Remark Set 44:

Much of this I have worked out using PFS File & PFS Report. When we had to give up our IBM, I switched to Condor for the Zenith.
[This respondent included several printouts from his system and made the following remark on one related to the specific parameters for a specific project (a design schedule printout)]

Did have estimated total time and time spent to date but could not get support from either my boss or my employees.

Remark Set 45:

[With respect to question 15, names of engineers/architects involved in the project, respondent left answer space blank]

We have a team concept.

[With respect to question 20, calculation of number of projects by a certain date]

Rather have a graphic presentation that we can project on screen (say at CO's Update) & run real time hardcopies!

[With respect to questions 21, 23, 24, and 26, calculation of effects of working overtime, calculation of the effects of shuffling relative priority, calculation of effects of indirect labor, all calculations to be made on the basis of manhours available by discipline and/or by specific person. The respondent rated all of these as "Not Useful"]

Our philosophy --- all the 4's above tell you that you use manhour calculations to show "that you can't get there from here" --- i.e., it works against you.

[With respect to questions 40 through 51, Manhour Accounting, the respondent answered all of these as "Not Useful"]

All of the above is "management of the management system"; micromangement; far too time consuming and busy

work.

[With respect to questions 73 and 74, Telephone Modem, respondent answered both of them "Very Useful"]

We have our computer interfaced with our word processing system and use Master Spec (AIA).

[REMARKS]

Looks like you have some super ideas going.

Remark Set 46:

Keep it simple!

Remark Set 47:

To go to a total management system such as whims [sic] will be a nightmare to keep updated. It would require a clerical person constantly updating the system to make it workable. We have a "mobile" society that does not work at a position for over a two year period. No reflection on our workers. They are good, but they transfer with their spouses and then we are back to training mode for about 6 months to a year and we enjoy for a year. With the present grade structure this can never keep qualified personnel. We will always be placed in a position of "garbage in and garbage out" situation. I foresee spending the last hour of the day doing nothing but "busy" work trying to update all information to be fully useful. As a taxpayer we are trying to over manage with a "whims" system with a lot of unnecessary information and data. Very similar to the

total programming system that was scrapped after thousands of dollars were spent gathering data to set the program up.

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UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	UNCLASSIFIED
1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
3. DISTRIBUTION/AVAILABILITY OF REPORT	Approved for public release; distribution unlimited
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	AFIT/GEM/LSM/85S-13
5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION	School of Systems and Logistics
6b. OFFICE SYMBOL (If applicable)	AFIT/LS
7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State and ZIP Code)	Air Force Institute of Technology Wright-Patterson AFB, Ohio 45433
7b. ADDRESS (City, State and ZIP Code)	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	
8b. OFFICE SYMBOL (If applicable)	
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State and ZIP Code)	
10. SOURCE OF FUNDING NOS.	PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT NO.
11. TITLE (Include Security Classification)	See Box 19
12. PERSONAL AUTHOR(S)	Jonathon P. Miller, M. Arch., GS-12 and Wendell A. Trivette, B.S.C.E., 1st Lt, USAF
13a. TYPE OF REPORT	MS Thesis
13b. TIME COVERED	FROM ____ TO ____
14. DATE OF REPORT (Yr., Mo., Day)	1985 September
15. PAGE COUNT	122
16. SUPPLEMENTARY NOTATION	

17. COSATI CODES		
FIELD	GROUP	SUB. GR.
05	01	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Decision Support Systems, Management Information Systems, Information Systems, Civil Engineering, Engineering Management, Man Computer Interface, Design Management

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Title: IDENTIFICATION OF DESIRED COMPUTER CAPABILITIES FOR MANAGEMENT OF AN AIR FORCE BASE LEVEL CIVIL ENGINEERING DESIGN OFFICE

Thesis Chairman: James D. Meadows, GM-13

Approved for public release: IAW AFR 190-1.
Lynn Wolaver 11 Sept 85
LYNN E. WOLAVER
Dean for Research and Professional Development
Air Force Institute of Technology (ATC)
Wright-Patterson AFB OH 45433

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS ☐
21. ABSTRACT SECURITY CLASSIFICATION	UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL	James D. Meadows, GM-13
22b. TELEPHONE NUMBER (Include Area Code)	(513) 255-4149
22c. OFFICE SYMBOL	AFIT/LSMA

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

Computer Systems are becoming more important in the management of the different branches within an Air Force Civil Engineering organization. One of the primary items that determines the effectiveness and efficiency of a computer system is the development of the software. Before the software can be developed, the desired capabilities of the computer system need to be identified.

This thesis identifies computer capabilities that Chiefs of Engineering Design and their immediate supervisors desire for use in managing base level Air Force Civil Engineering Design Offices in the Continental United States. These capabilities were identified by having managers from engineering branches in Air Force Civil Engineering organizations evaluate 74 potential computer capabilities. Respondents were also able to comment on the identified capabilities and to identify any other capabilities that they may desire. The many and in some cases quite lengthy comments received show that the respondents are interested in this subject.

The vast majority of respondents' comments were very positive and expressed their need for help in developing required computer support. In response to this requirement, many bases have procured minicomputers and the Air Force is in the process of procuring computers for the Work Information Management System (WIMS) for each base. WIMS is a series of desktop terminals connected to a central computer system with a common data base for use by all Civil Engineering managers. The results of this thesis will be used in the development of software for the WIMS computers.

The identified computer capabilities are prioritized in two different ways. First, they are prioritized based upon the percentage of respondents classifying a particular capability as "very useful." Second, they are prioritized based upon the percentage of respondents classifying a particular capability as "very useful" or "moderately useful." These priority lists are not intended to show what capabilities should or should not be developed, but only as a means to focus resources in the development of the capabilities.

The effects of various demographic factors upon the perceived usefulness of the identified computer capabilities were analyzed. The analysis was accomplished by dividing the respondents into nine different groups based upon the responses to the demographic questions contained in the questionnaire. There were no major differences between the groups.

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